AIR MOBILITY COMMAND

AIRCRAFT INDUSTRIAL SUPPORT FACILITIES DESIGN GUIDE

AMC aircraft maintenance facilities must provide excellent environments for our people to perform their vitally important work. To have a quality force that turns out quality products consistently, our maintenance facilities must give positive evidence that people are our most valuable resource.

This guide provides the means for planning, programming, and designing facility projects that provide quality backshop facilities needed to produce and repair aircraft parts and put them in the hands of our maintainers when they need them. Use this guide as a blueprint for developing a facility investment program that will bring aircraft maintenance industrial facilities up to AMC standards. The result will be improved morale and productivity for our people and greater mission capability of the Air Mobility Team.

"The Air Mobility Team…Responsive Global Reach for America…Every Day!"

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Chapter 1
Introduction

A. Purpose

This design guide provides the basic criteria to organize, evaluate, plan, program, and design Air Mobility Command (AMC) Aircraft Industrial Support Facilities (AISF). It applies to the design of all new construction and renovation projects. The information presented is intended to make commanders and their staff aware of important design considerations and to aid them in project development. Quality facilities will improve the maintenance specialists efficiency and ability to service and repair equipment and encourage pride of ownership in their workspace.

AISF includes both Aircraft Maintenance Shops (AMS) and Alternate Mission Equipment (AME -21) maintenance and storage facilities. AMS, also known as General Purpose Maintenance Shops or Backshops, are an essential component of aircraft operations. They provide facilities for manufacturing (both light and heavy), inspection, repair, and recovery to support all aircraft types in the AMC inventory. AME -21 facilities are involved in the day-to-day mission assignments of all aircraft types in the AMC inventory.

This guide is for use by commanders, logistics personnel, base civil engineers, headquarters staff, design architects and engineers, and others involved in AISF design and construction. It is intended to help participants better understand facility requirements and design criteria so they can effectively participate in the project development process. Use this guide to supplement other Air Force and Department of Defense policies, instructions, and standards.

B. Project Development

The key elements to successful facility delivery are planning, programming, design, and construction. Planning and programming for AISF facilities should consider all aspects of the operation, as well as maintenance, service, repair, and storage of various equipment types.

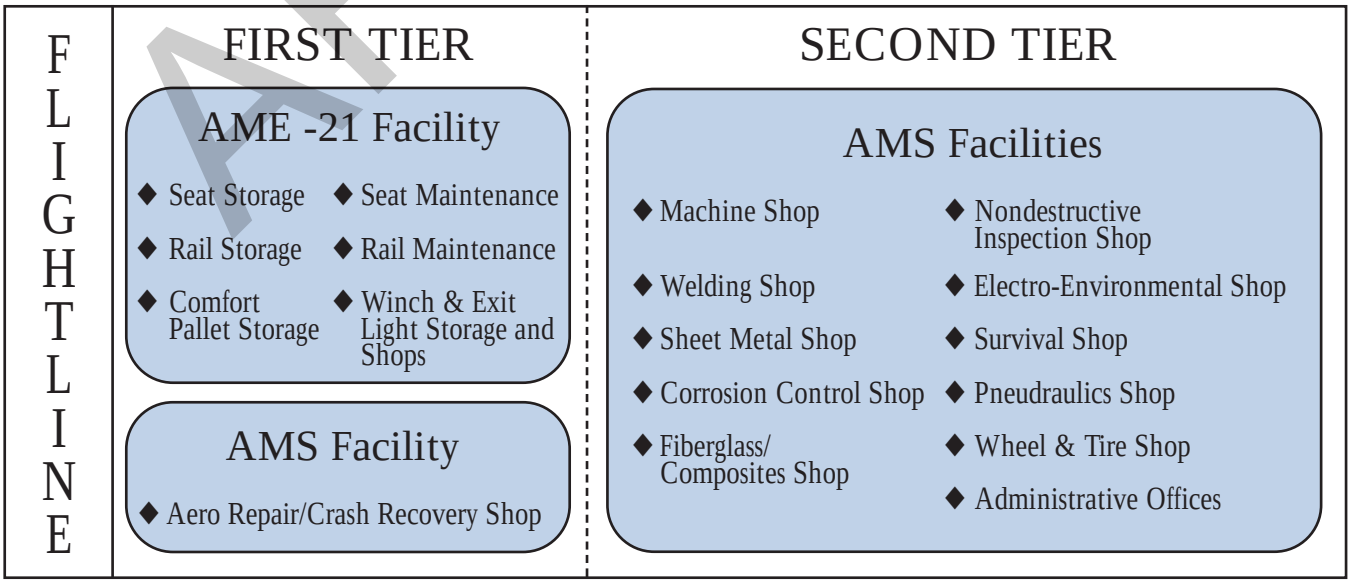


Figure 1-A AISF Organizational Diagram.

1. Planning

Effective planning will establish and support the overall objectives for AISF facilities. It should also lead to a timetable for project completion. Planning must be long term.

The siting of AISF facilities is important. AMS facilities require access to the flightline, but do not need to be located on the flightline. Due to the diverse nature of the shops included in the AMS facility, multiple buildings may provide the most effective solution to site utilization. Many functions are easily located together, but those most suitable for a separate building include the survival shop, the electro-environmental shop, the nondestructive inspection shop, the corrosion control shop, and the fiberglass/composites shop.

Locate AME -21 facilities on the flightline, preferably near the center of the aircraft parking apron where the aircraft are serviced. This will minimize travel time to and from aircraft being prepared for a mission.

The sites must be large enough to accommodate the intended functions and allow reasonable access to all functional areas. Whenever possible, allocate space for facility expansion in order to adapt to future base mission reassignments or additional aircraft capacity. Local weather conditions, soil analysis, and utility availability are other variables to consider in site selection.

When planning a new facility, initial site selection must be accomplished prior to completing DD Form 1391, Military Construction Project Data. Additional requirements identified during the DD Form 1391 phase may require an alternate site selection.

2. Programming

Programming includes determining user requirements, developing solutions, identifying funding sources, and forwarding programming documents to the appropriate review and approval authorities. Each programmed project should be consistent with the base comprehensive plan for new and existing facilities. Work is classified as maintenance, repair or construction. Information required during preparation of the DD Form 1391, which initiates project development, is found throughout this guide. Included are space criteria, overall facility size, and special factors for consideration in estimating costs.

3. Design

Design includes concept development, design reviews, and construction documents. It is important for civil engineering and the user to actively communicate throughout the design process to bring about a successful project. A high quality design will maximize effective use of available space and provide efficient AISF facilities. Throughout the entire design process give preference to the use of environmentally friendly materials as described in Air Force Environmentally Responsible Facilities Guide.

Compliance with all applicable building codes is mandatory. Life safety code requirements take priority over other facility improvement requirements. All areas should be barrier free and accessible to the disabled in accordance with the Americans with Disabilities Act (ADA) and Uniform Federal Accessibility Standards (UFAS).

Prepare a comprehensive interior design (CID) package for the AISF facility in conjunction with any major design project. The CID package addresses interior finishes, artwork, signs, and furnishings. It ensures that even minor upgrade projects meet the design objectives for the entire facility. Refer to the AMC Interior Design Guide for an expanded discussion of interior design.

Integration of infrastructure, engineering, architectural, and interior design issues throughout the design process will result in a well coordinated design. Analyze an existing facility's structural, mechanical, electrical, and communications systems prior to planning renovation projects. Refer to DoD, Air Force standards and technical orders, Industrial Standards, and Aircraft Manufacturer's recommendations for maintenance requirements. Include infrastructure improvements concurrently with interior finish work.

4. Construction

Quality reviews of the contractor's submittals by project engineers and daily on-site inspections by civil engineering construction management personnel and the user will help ensure that design goals are achieved.

Chapter 2

Exterior Elements

A. General

The exterior elements of the project significantly contribute to the overall appearance of the facility. This chapter addresses the concept site plan, parking areas, entrances, building materials/design, landscape, signs, utilities, lighting and outside storage areas. The Architectural Compatibility Guide for each base will assist in the design of these elements. The overall complex should present a cohesive architectural image. Buildings and shops can be grouped as local conditions permit.

B. Site Design/Improvements

1. Access

Provide access to the AISF facilities from the flightline, base roadways and personnel parking lots. Access is also required for delivery of bench and shop stock to the various maintenance shops, and for hazardous material pick-up.

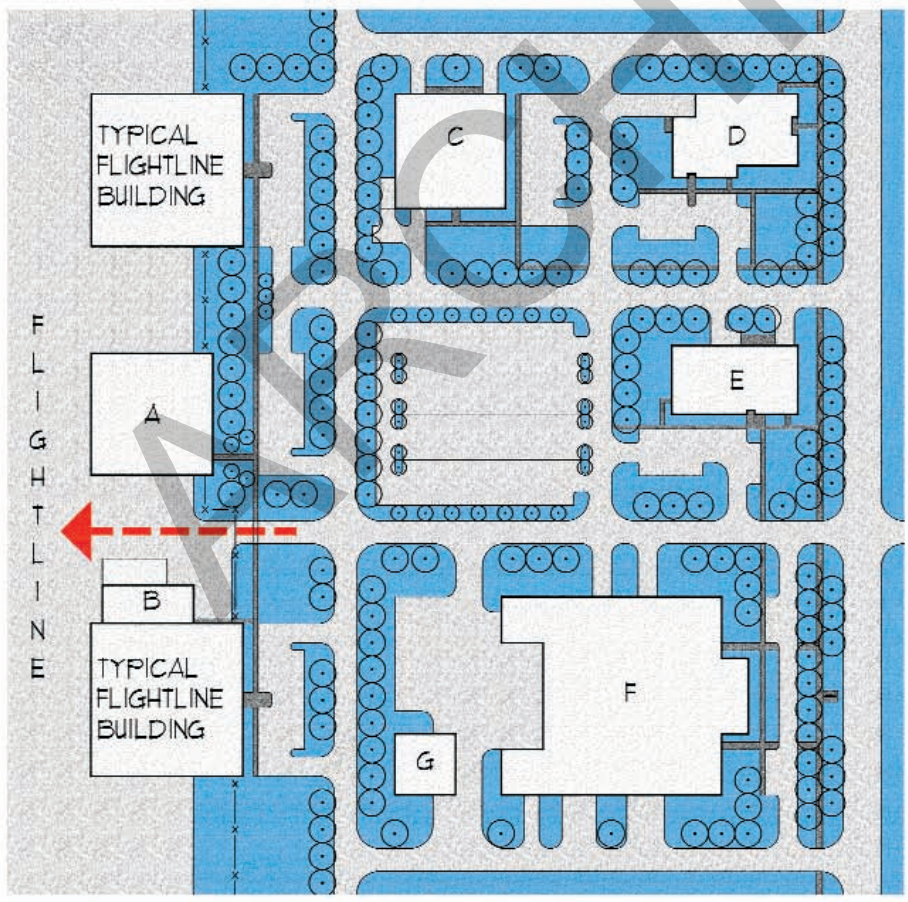


Figure 2-A Concept Site Plan.

2. *Parking*

Provide all AISF facilities with parking areas for visitors, personnel and official vehicles. Locate visitor and handicapped parking close to the main entrance. Provide separate customer parking spaces for the Survival Shop fabrication section and for the NDI Shop's oil analysis drop-off area. Allow a minimum of 35 square yards per vehicle for planning of parking areas. This allowance includes maneuvering and circulation space in addition to parking space. Provide 90 degree parking whenever practicable.

3. *Entrances*

The facility entries and entry paths should be easily identifiable to the first-time visitor. Design the main entrance to provide protection from the weather whenever practicable. Place the customer service entrance for the Survival Shop and the NDI Shop near the point-of-service area inside the facility and with easy access from customer parking. Provide for vehicle loading/unloading doorways of adequate size to permit delivery of large equipment and components such as life rafts and aircraft subassemblies.

Provide separate personnel and customer entrances.

4. *Building Materials/Design*

Construct new facilities with building materials in context with the base's architectural theme. Select materials that are durable and require minimal maintenance. Comply with the airfield clearance requirements for building height and setbacks in accordance with AFJM 32-1013, Airfield and Helicopter Planning and Design.

5. *Landscape*

Landscape elements help create an attractive facility. These elements define the site, add visual interest, enhance the main entrance, and visually screen utilitarian areas (mechanical/electrical equipment, dumpsters, etc.). Landscape elements include earth berms, trees and shrubs, pavement materials, site amenities, screen walls, fences, signs, and lighting. Provide low maintenance landscape and select only base-approved, native plant materials. Refer to the AMC Landscape Design Guide for specific information.

6. *Signs*

Exterior signs include facility, directional, parking, and flammable code signs and must comply with the AMC sign standards. See AFM 91-201, Explosives Safety Standards, to determine if fire symbol signs are required on the outside of buildings.

7. *Utilities and Lighting*

Whenever possible, locate utility lines underground to avoid visual "clutter," and overhead obstructions to the movement of large equipment. Provide photo-cell controlled lighting for safety and security at all parking areas, walkways and entrances. Install additional lighting as required for night operations. Use high-intensity discharge light sources for all exterior illumination. Provide exterior engine warming receptacles as needed in severe cold weather climates for equipment as well as government owned vehicles (GOV) and private owned vehicles (POV).

Chapter 3

Common Functional Areas

A. General

This chapter presents criteria for designing areas which are common to both the AMS and the AME -21. Design considerations are given to indicate the use and basic requirements of each functional area. Equipment, storage, and special utility requirements are also discussed. These recommendations may be modified to reflect mission requirements.

B. Administration Areas

1. General

This section addresses administrative space requirements for the facilities as a whole and also administrative space requirements within each shop area. The general administrative spaces for all of the shops can be consolidated, thereby conserving overall building space for use by specific functional areas.

2. Entrance/Lobby

The public entrance to the facility should be readily discernible from the parking lots. Provide an air-lock type vestibule with an independent heating system. In the lobby area, provide a public telephone, drinking fountain, and a visitor reception/waiting area.

3. Staff Offices

The staff is accommodated in two areas. The general administrative staff offices consist of the command structure of the unit and the support staff necessary for the day-to-day tracking of materials and personnel. Furnish these staff areas with open-office type systems furniture. Provide private offices with suitable furniture for the unit commander and senior supervisors.

Shop supervisors are generally Senior Non-Commissioned Officers or civilians. These personnel require private offices that are efficient in design and contain durable, easily maintained furniture and finishes suitable for the industrial nature of the function. Locate these offices adjacent to each respective work area. Acoustically treat the offices to minimize noise levels produced by shop activities.

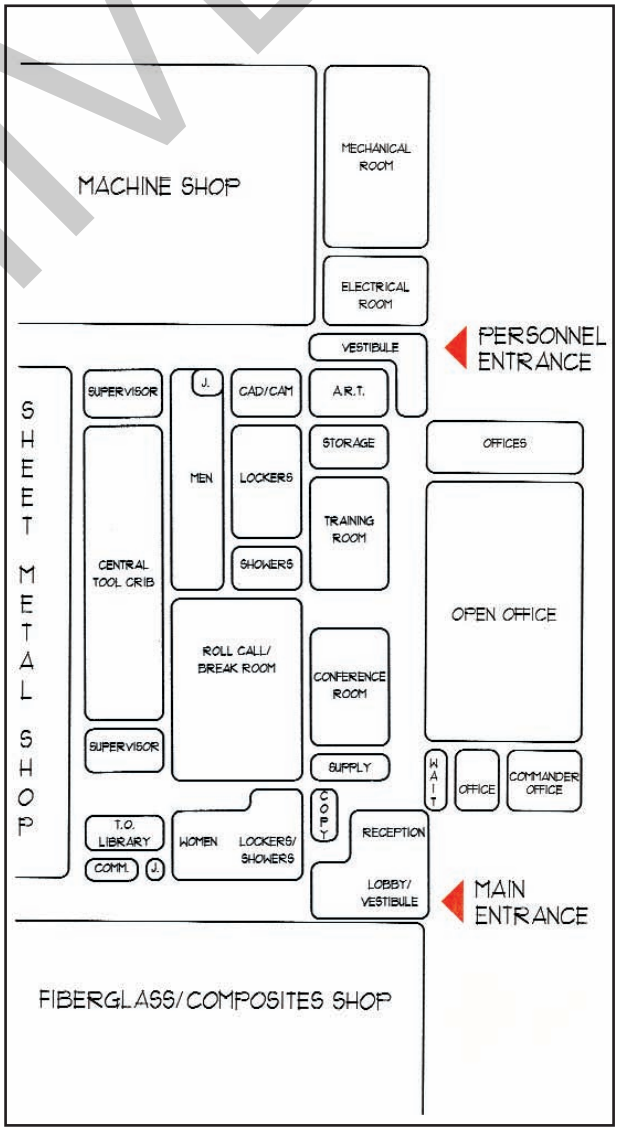


Figure 3-A: Functional Area Relationships.

4. Air Reserve Technician (A.R.T.) Office
At certain installations, Air Reserve Technician personnel require a private office. Provide a lockable office area with a secured storage closet.

5. Roll Call/Break Room
The roll call/break room contains a space large enough to assemble personnel from the various shops for staff meetings. It also functions as the work-break/ lunch room for personnel. Equip this room with a refrigerator, ice maker, microwave, coffee maker and sink with hot/cold water and a garbage disposer. Provide wall and base cabinets with countertop to assist in food preparation and storage. Allow space for vending machines with water hookups if necessary. Optional accessories include a television, radio, and bulletin board. Locate this room near conference and training rooms to support group activities.

6. Conference/Training Areas
Provide a multi-purpose space for conducting staff briefings, meetings, and technical training. Design the space to provide overhead, slide, and video projection. Also, include ample wall space for chalk/marker/tack boards and projection screens. Provide multiple switching and dimming controls to obtain appropriate, quality lighting levels. Locate an outlet in the floor for convenient electrical connection of equipment. Provide an acoustical rated operable partition to divide the room allowing simultaneous conferences and training sessions. Furnish the conference/training room with durable, easily maintained tables and chairs. Provide multiple unit level training booths/rooms furnished with special equipment to fit the training criteria.


Roll call/break rooms are utilized for various activities.


Conference/training rooms are used for ongoing educational classes and meetings.

C. Support Areas

1. General
Support areas include storage areas, supply/copy room, rest rooms, locker rooms, janitor's closet, mechanical rooms, and electrical/communication rooms. Provide drinking fountains in convenient locations.

2. Storage Areas
Storage areas include tool cribs, bench stock, technical order (T.O.) library and material storage. Centrally locate tool cribs and bench stock areas to provide support for all shops in the facility. Include a T.O. library area for technical manuals with easy access to all shop areas. Provide computer stations as required to access data. Include material storage areas at each individual shop for ease of access.

3. Rest Rooms/Locker Rooms
Locate rest rooms within the facility to serve both administrative and technical staff. Provide separate men's and women's facilities. Each should have direct access to appropriate lockers and showers. Use electronic sensor faucet and wash stations to control on and off water flow.

4. Janitor's Closet
Include a mop sink, a small counter, storage shelves, and hooks for cleaning supplies and maintenance equipment.

5. Mechanical Room

The mechanical room should include adequate space for the HVAC and fire detection/prevention/alarm equipment. Locate this room away from administrative areas and provide sound insulation to prevent noise from disrupting activities. Include a double service door to the exterior and a concrete ramp for the convenient moving of large equipment and parts into the room.

6. Electrical/Communications Room

Provide an area for electrical service, to include distribution equipment, wiring, receptacles, grounding, interior and exterior lighting, controls, emergency lighting, security and fire alarms, commercial telephone service, and Local Area Network (LAN). Wall-mount power and telephone distribution equipment and floor-mount the LAN computer file server. Install a system of conduits (or raceways) for telephone and computer wiring with a central feed to this room. Locate conduits and raceways for accessibility. Size the conduit and provide nylon pulling lines to facilitate future additions or modifications to wiring systems.

Functional Space Requirements for Administration and Support Areas(1)

Functions	Net Square Feet	Net Square Meters(2)
Entrance/Lobby	200	19
Reception/Waiting	300	28
Commander's Office	200	19
Staff Offices(3)	900	84
Open Office(4)	2,700	250
A.R.T. Office/Storage(5)	400	37
Roll Call/Break Room(6)	1,500	139
Conference Room(7)	500	46
Training Room(7)	500	46
Supply/Copy Room	300	28
Tool Crib/Bench Stock	1,400	130
T.O. Library	350	33
Rest Room/Locker/Shower Rooms	1,300	121
Janitor's Closet	80	7
Mechanical Room(8)	1,100	102
Electrical/Communications Room(8)	350	33
Subtotal	12,080	1,122
Walls & Circulation (20%)	2,420	225
TOTAL	14,500	1,347

Table 3-A: Functional Space Requirements for Administration and Support Areas.

Legend for Table 3-A.

(1) Example is based on 1 Air Mobility C-17 Wing and a facility that contains Metals Technology and Structural Maintenance Shops.
(2) Square Meters = .0929 x Square Feet (All measurements are rounded).
(3) Allow 144 SF per person.
(4) Square Footage is based on 25 pre-wired work stations @ 108 SF each.
(5) A.R.T. requirements vary by base and mission.
(6) Square Footage is based on 75 seats at 15 SF per seat, plus vending area.
(7) Square Footage is based on 25 seats at 20 SF per seat.
(8) Allocate approximately 10% of the total area for mechanical, electrical, and communications room.

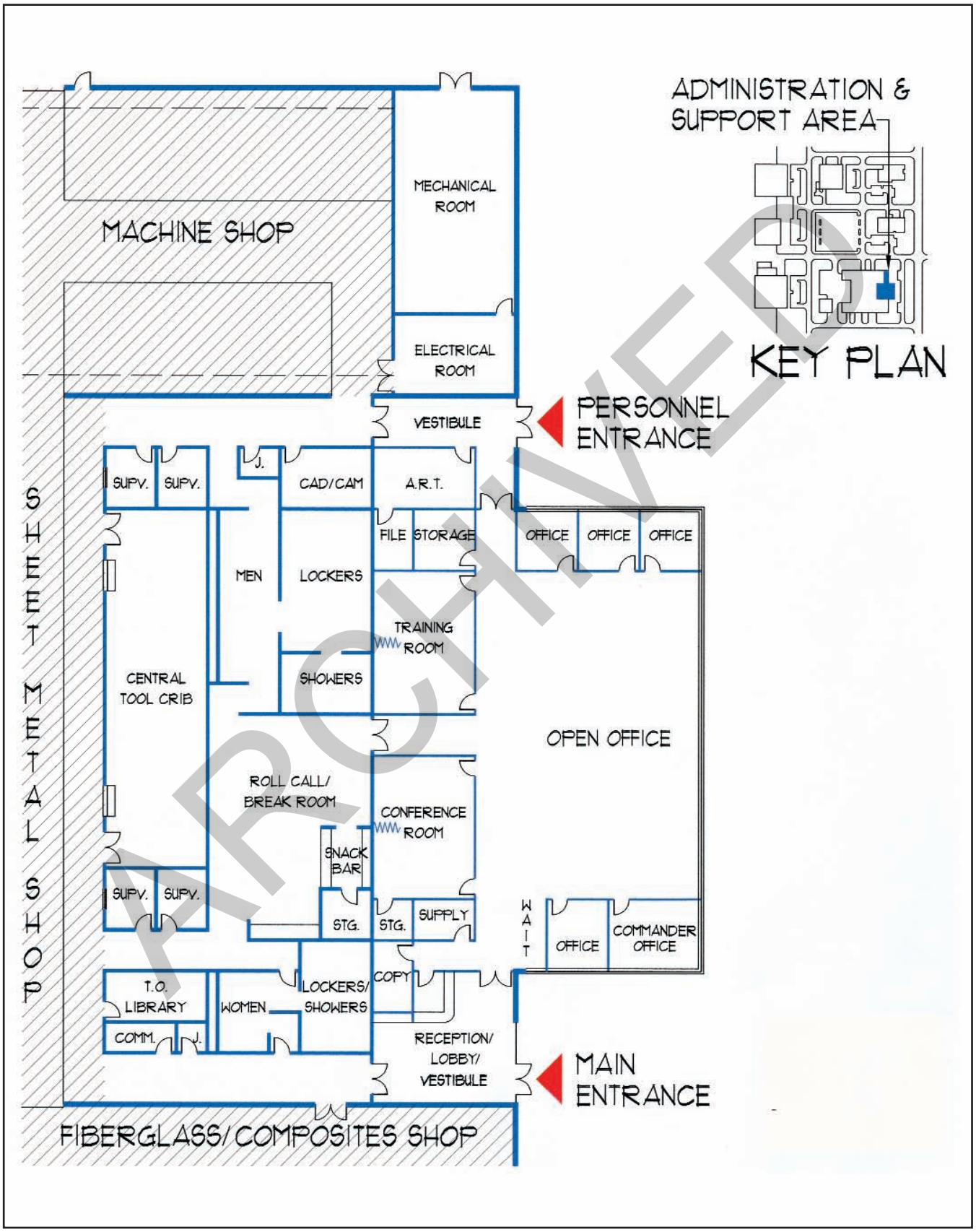


Figure 3-B: Concept Floor Plan for the Administration and Support Areas.

Chapter 4

AMS Functional Areas

A. General

This chapter presents criteria for designing areas which are contained in the Aircraft Maintenance Shops (AMS) function of the AISF. Design considerations are given to indicate the use and basic requirements of each functional area. Equipment, storage, and special utility requirements are also discussed. These recommendations may be modified to reflect mission requirements. AMS shops provide facilities for manufacturing, inspection, repair, and recovery to support all of the aircraft at any particular base.

Shops include metals technology (machine and welding), structural maintenance (sheet metal, corrosion control, and fiberglass/composites), nondestructive inspection, electro-environmental, survival, pneudraulics, wheel and tire and aero repair/crash recovery shops.

Provide overhead doors, of sufficient size, to permit delivery of large parts or assemblies to the shops. Locate doorways to coordinate with overhead crane travel routes inside the building.

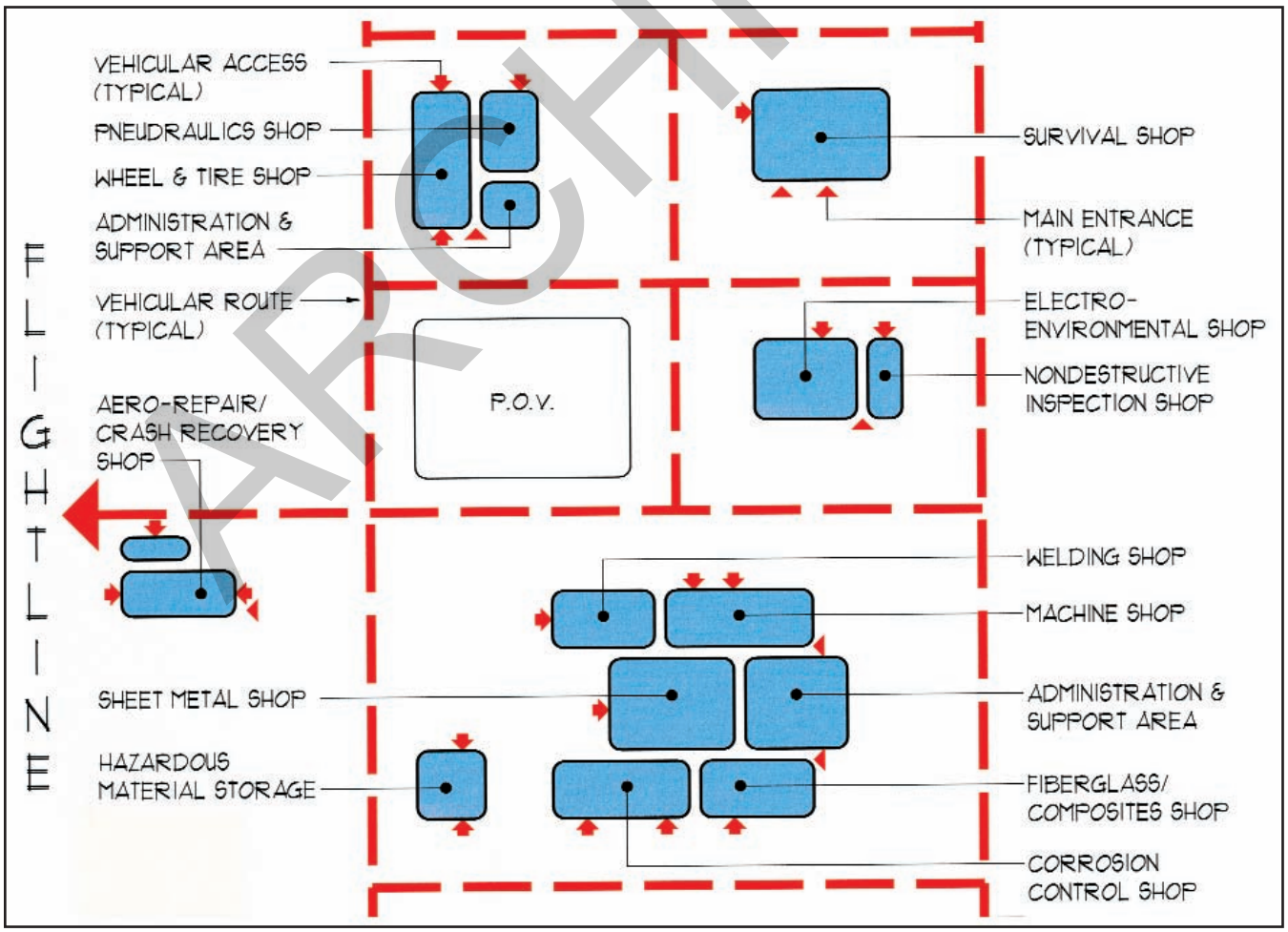


Figure 4-A1: Functional Area Relationship for the AMS Facilities Campus.

Minimum Space Requirements for Aircraft Maintenance Shops[1]		
Mission Type	Gross Area	
	Square Feet	Square Meters
1 Air Mobility Wing (C-17)	107,000	9,940
1 Tanker Wing (KC-135)	91,000	8,454
1 Air Mobility Wing (C-5)	107,000	9,940
1 Air Mobility Wing (C-5/KC-10)	118,000	10,962

Table 4-A1: Minimum Space Requirements for Aircraft Maintenance Shops.

Aircraft Maintenance Shops Minimum Space Requirements[1]								
	Gross Area							
Aircraft Type	C-17[2]		KC-135		C-5		C-5/KC-10	
Function	SF	SM	SF	SM	SF	SM	SF	SM
Squadron Administration and Support[3]	14,500	1,347	12,500	1,161	14,500	1,347	16,500	1,533
Machine Shop	8,500	790	8,500	790	9,000	836	10,000	929
Welding Shop	5,500	511	5,500	511	5,500	511	6,000	557
Sheet Metal Shop	10,000	929	10,000	929	15,000	1,394	20,000	1,858
Corrosion Control Shop	8,500	790	9,000	836	9,500	883	10,000	929
Fiberglass/Composites Shop	8,500	790	8,000	743	8,000	743	8,500	790
Nondestructive Inspection[4]	4,000	372	4,000	372	4,000	372	4,000	372
Electro-Environmental Shop	12,500	1,161	9,000	836	9,000	836	9,000	836
Survival Shop	14,000	1,300	10,500	975	13,500	1,254	13,500	1,254
Pneudraulics Shop	7,500	697	4,000	372	5,000	465	6,000	557
Wheel and Tire Shop	7,500	697	6,000	557	6,500	603	7,000	650
Aero Repair/Crash Recovery Shop	6,000	557	4,000	372	7,000	650	7,000	650
TOTAL AMS	107,000	9,940	91,000	8,454	107,000	9,940	118,000	10,962

Table 4-A2: Aircraft Maintenance Shops Minimum Space Requirements.

Legend for Table 4-A1 and 4-A2.
SF = Square Feet SM = Square Meters =.0929 x Square Feet (All measurements are rounded).
(1) Space requirements are based on a Wing and Type of Aircraft. 1 Wing = 4 Squadrons = 48 Aircraft.
(2) See C-17 Aircraft Manufacturer Facility Recommendations for additional information.
(3) Squadron Administration Area will vary based on number of authorized personnel. Allow 162 SF (15 sm) per occupant. Squadron Administration includes office, administration support and special purpose spaces.
(4) Area requirements for NDI per T.O. 33B-1-1.

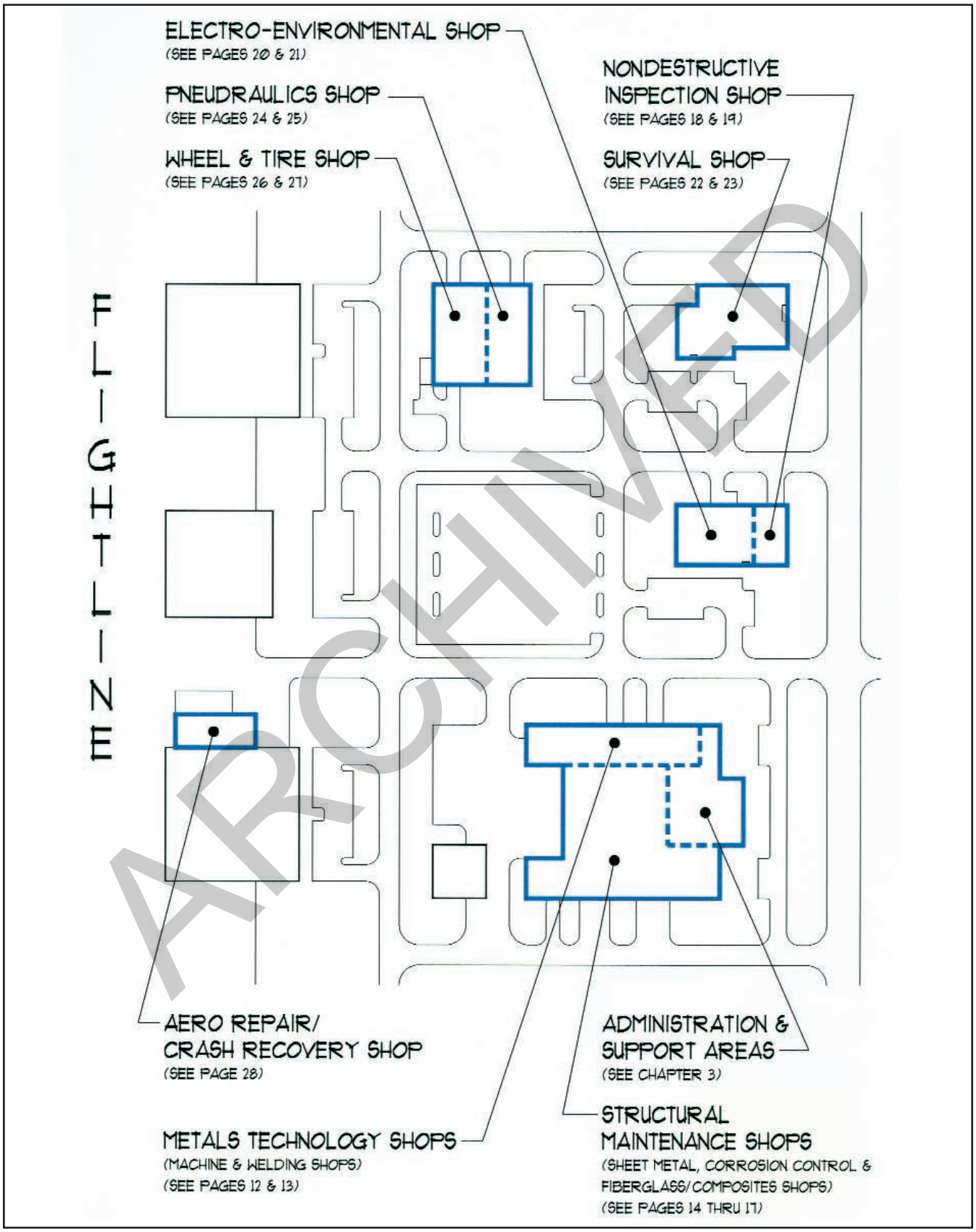


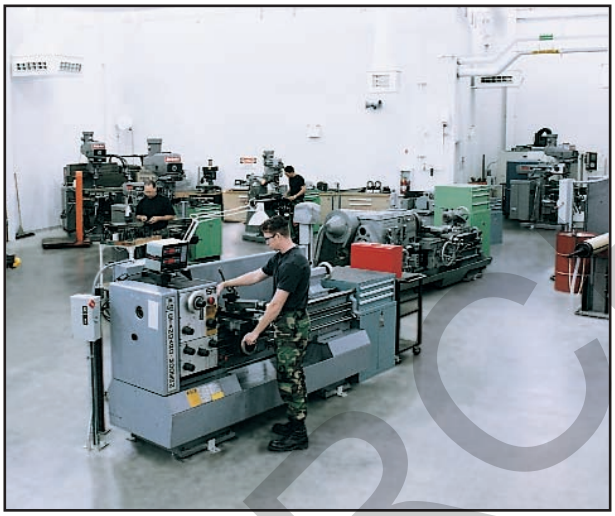
Figure 4-A2: Concept Plan for the AMS Facilities.

B. Metals Technology Shops

1. General

Metals Technology Shops include the machine shop and the welding shop. A well-equipped machine shop is vital to the overall mission of aircraft maintenance and repair. Aircraft component parts ranging in size from small brackets weighing a few ounces to large structural components are manufactured and/or repaired in these shops. Use sound attenuating construction materials and systems to reduce ambient noise levels in the shops.

The welding shop supports both the machine shop and the sheet metal shop and performs welds on all types of metals using various welding methods.



Provide adequate working and safety clearance around each piece of equipment in the machine shop.

2. Shop Equipment

Equipment required in the machine shop varies depending on the functions performed, but will generally include lathes, drill presses, band saws, grinders, and computer numeric control (CNC) multi-function tools. Equip the welding shop with welding curtains, welding machines, grinders, and material handling devices.

3. Material Storage

The machine shop requires a material storage rack for bar stock, plate stock, and other large pieces of various metals used in fabricating aircraft parts. Provide storage cabinets in the welding shop suitable for small items and ready use welding supplies. Local manufacturing needs may require additional welding shop storage space.

Install point source fume exhaust systems in the welding shop.

4. Special Equipment

Provide a 2 ton bridge crane spanning the material storage and work areas and 1 ton hoists at strategic locations in the machine shop. Furnish a 1 ton capacity monorail system with two, 1/2 ton hoists for handling parts in the welding shop. Computer aided drafting/computer aided manufacturing (CAD/CAM) equipment will be required to provide design parameters to CNC machines for automatic part fabrication. When CAD/CAM equipment is utilized, include a separate room to house the computer terminal. This room can be adjacent to other administrative functions but must be near enough to the CNC machines to allow efficient cabling between the two spaces.

5. Special Utility Services

Maintain regulated temperature and humidity conditions to prevent CNC/CAM equipment failures, corrosion of equipment and machined parts, and to assure accuracy of machined parts. Point source exhaust systems must be installed at welding stations to eliminate welding fumes with general filtration used throughout shop to eliminate airborne smoke and cutting fluid mists. The metals technolgy shop requires a 150 psi high volume shop air source for specialized equipment and for general hand tool operations. Industrial equipment may require 480 and 240 volt, 3 phase electricity.

Functional Space Requirements for the Metals Technology Shops[1]		
Functions	**Gross Area**	
	Square Feet	**Square Meters[2]**
Machine Shop		
Shop Administration	150	14
Shop Area	7,250	673
CAD/CAM Room	200	19
Support Areas[3]	900	84
Subtotal	8,500	790
Welding Shop		
Shop Administration	150	14
Welding Booths	850	79
Shop Area	3,600	334
Support Areas[3]	900	84
Subtotal	5,500	511
TOTAL	14,000	1,301

Table 4-B: Functional Space Requirements for the Metals Technology Shops.

Legend for Table 4-B.

(1) Example based on 1 Air Mobility C-17 Wing.
(2) Square Meters = .0929 x Square Feet (All measurements are rounded).
(3) See Chapter 3, Section C, for description of Support Areas.

Note: If the Welding Shop and Machine Shop are in a stand alone building, then space for Bench Stock, Tool Crib, Technical Order Library, and Rest Rooms should be provided.

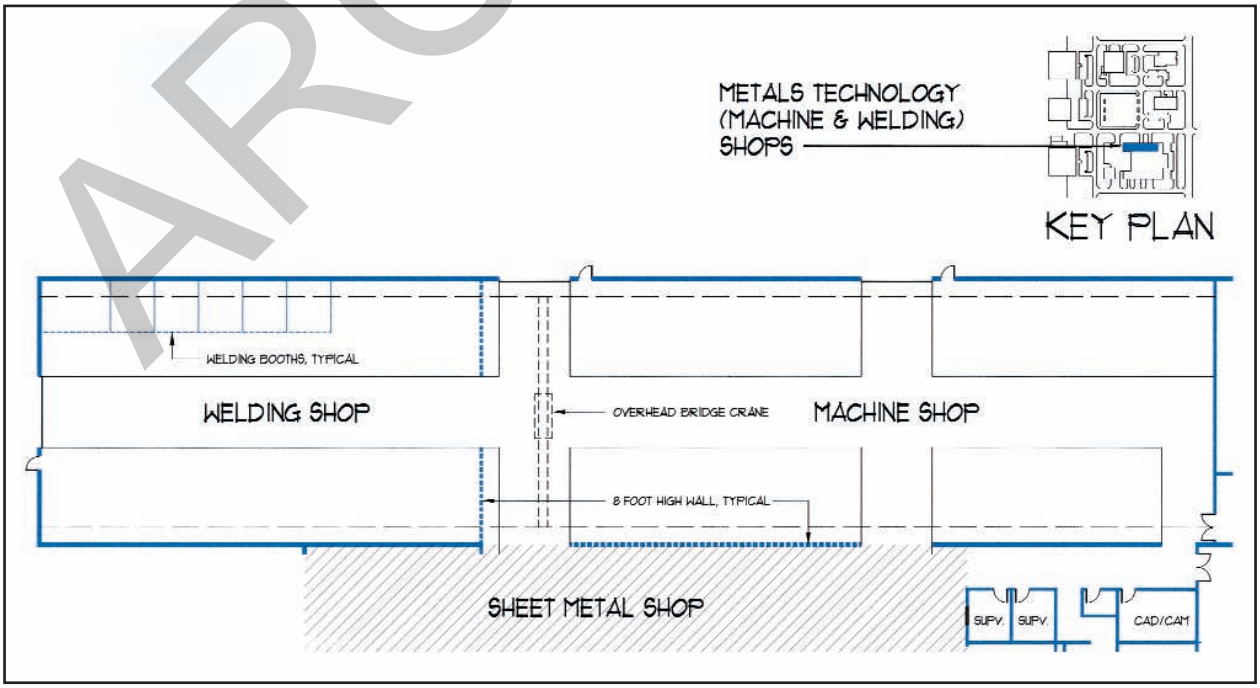


Figure 4-B: Concept Floor Plan for the Metals Technology Shops.

C. Structural Maintenance Shops

1. General

Structural maintenance shops include the sheet metal shop, the corrosion control shop, and the fiberglass/composites shop.

The sheet metal shop provides essential repair and manufacture of aircraft components ranging from flight control surfaces and skin sections to brackets and equipment housings. A well-equipped sheet metal shop promotes aircraft readiness and is vital to the overall mission of aircraft maintenance and repair. Use sound attenuating construction materials and systems to reduce ambient noise levels in the shops.

Provide isolated foundations for heavy machinery in the sheet metal shop.

A corrosion control shop is necessary to prolong the useful life of components and equipment. By so doing, it will promote morale by presenting a professional appearance, and enable working personnel to be more efficient by having clean, well functioning equipment to utilize in their daily duties.

Aircraft parts, such as composite surfaces and components, aircraft skin sections, toilets and galleys, are repaired and manufactured in the fiberglass/composites shop.

2. Shop Equipment

Equipment required in the sheet metal shop will vary depending on the tasks performed, but will generally include shears, breaks, punches, cutters, drill presses, and grinders. Provide adequate space for each piece of authorized shop equipment. Ensure that the working and safety zone around each piece of equipment is considered.

Sand and/or bead blasting is used to prepare surfaces to receive paint. A small enclosure with a self-contained bead-blast system is adequate for many components. Provide a large sealed area for preparation of oversized parts. The sand/bead blasting area also supports the metals technology shops. Provide for clean/dirty room operations in this shop.

A typical pre-engineered paint booth equipped with lighting and filter systems.

The paint booth must be large enough to accommodate the largest component that will be processed on a regular basis. It should have a paint filtration system.

A paint mixing room, separate from the paint booth, is required to isolate any hazardous fumes from the remainder of the corrosion control shop. This room will contain paint mixing equipment, fume hood and a daily use paint locker for temporary storage of hazardous materials such as paints and thinners.

Work tables in the fiberglass/composites shop must be large enough to accommodate the components being worked on and still allow personnel to easily access all sides of the component. Provide a containment area at floor level to capture drips and spillage from work tables. This room also contains storage areas for the various cloths and fabrics utilized.

Provide a woodworking shop for creating molds for manufacturing fiberglass and plastic components. Equip the woodworking shop with a table saw, a band saw, a miter saw, a drill press, various sanding machines, and possibly a planer and a joiner. Provide for powered hand tools as dictated by local needs.

Include a sawdust collection system in the woodworking shop.

3. Material Storage

The sheet metal shop requires a material storage rack for sheet stock of various metals used in fabricating aircraft parts. A movable rack storing the sheet stock on edge will facilitate stock selection. The composites shop requires refrigerators to store sheet adhesives utilized in composite component manufacture and repair. Paint and chemicals storage should also be provided.

An example of a sheet metal and bar stock storage system.

Provide an exterior hazardous materials storage facility. Locate it within easy access from both the corrosion control shop and the fiberglass/composite shop. This will allow hazardous materials to be stored in a nearby secure location, in quantities adequate enough to allow personnel to respond to customer demand. If enclosed, this storage facility must maintain temperatures between 10˚C (50˚F) and 27˚C (80˚F), and meet all federal, state, and local requirements.

4. Special Equipment

Equip the sheet metal shop with a 1 ton bridge crane spanning the material storage area and the majority of the work area. Also install 1/2 or 1/4 ton jib cranes at strategic locations required for material handling.

Provide a fenced and covered hazardous material storage facility in accordance with environmental laws and regulations.

Provide a paint booth with an integral filtration system in the corrosion control shop. Furnish clothing lockers sized to store protective suits.

Special equipment required in the fiberglass/composite shop includes ovens for curing completed projects and a monorail system with a 1/2 ton hoist for moving large items within the shop.

Provide the fiberglass/composites shop with a specialized ventilation system, which exhausts fumes to the outdoors. Preheat the air intake, or filter exhaust air for re-circulation. The woodworking shop requires a sawdust collection system. Prevent direct sunlight penetration, through exterior windows, as ultraviolet light affects the work and curing process.

5. Special Utility Services

Maintain regulated temperature and humidity conditions to prevent CNC/CAM equipment failures, corrosion of equipment and manufactured parts, and to aid in sealant/bonding agent curing. Structural maintenance shops require high volume 150 psi shop air for specialized equipment and general hand tool operation. Equipment may require 480 and 240 volt, 3 phase electricity. Corrosion resistant drains may be required.

Functional Space Requirements for the Structural Maintenance Shops(1)

Functions	Gross Area	
	Square Feet	Square Meters(2)
Sheet Metal Shop		
Shop Administration	400	37
Shop Area	7,500	697
Support Areas(3)	2,100	195
Subtotal	10,000	929
Corrosion Control Shop		
Shop Administration	300	28
Paint Booths	2,400	223
Paint/Solvent Storage	300	28
Paint Mixing Room	200	19
Preparation Area	1,800	167
Shop Area	2,000	186
Support Areas(3)	1,500	139
Subtotal	8,500	790
Fiberglass/Composites Shop		
Shop Administration	500	46
Preparation/Repair Area	3,900	362
Layup/Curing Room	2,000	186
Walk-in Freezer	100	9
Spray Booth	800	74
Support Areas(3)	1,200	111
Subtotal	8,500	790
TOTAL	27,000	2,508

Table 4-C: Functional Space Requirements for the Structural Maintenance Shops.

Legend for Table 4-C.
(1) Example based on 1 Air Mobility C-17 Wing.
(2) Square Meters = .0929 x Square Feet (All measurements are rounded).
(3) See Chapter 3, Section C, for description of Support Areas.

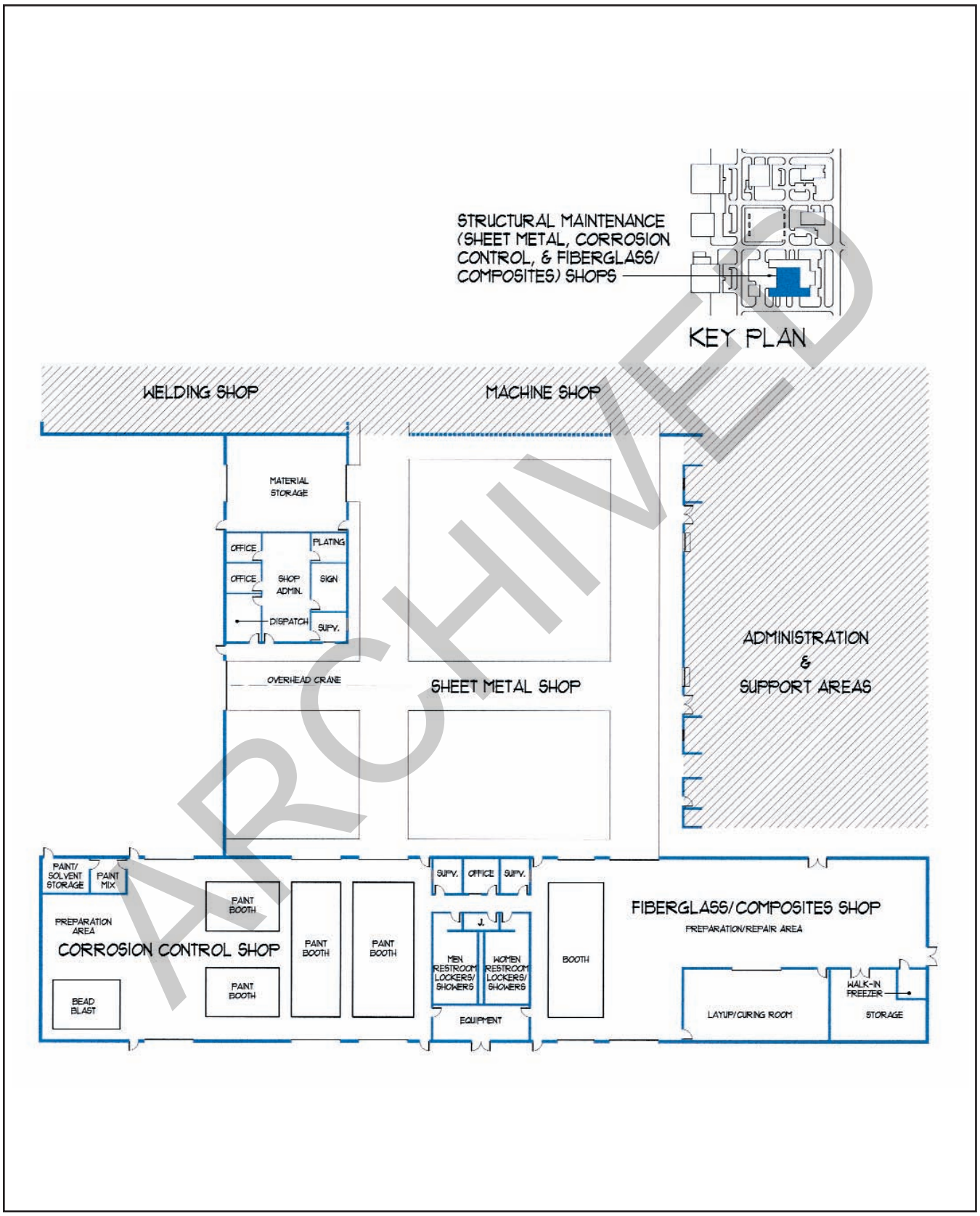


Figure 4-C: Concept Floor Plan for the Structural Maintenance Shops.

D. Nondestructive Inspection Shop

1. General

The nondestructive inspection (NDI) shop consists of testing facilities, administration, and laboratory space for housing the various nondestructive testing methods conducted at different bases. These methods include ultrasonic, fluorescent penetrate, magnetic particle, eddy current, radiography (X-ray), and, at some bases, spectrometric oil analysis. The eddy current and ultrasonic methods require storage cabinets for their particular equipment.

The other methods require more space and/or special equipment. T.O. 33B-1-1 Technical Manual Nondestructive Inspection Methods describes and illustrates a fully operational NDI shop. Refer to this T.O. for a detailed facility layout and additional requirements.

Locate fluorescent penetrate and magnetic particle testing in the same area. Both testing methods require a room long enough to accommodate their testing platforms.

The radiography (X-Ray) testing function requires a fully shielded room sized to completely enclose the largest single component that is routinely tested. The shielded room should have a fully shielded overhead or sliding exterior door. X-ray testing of extremely large components may require special shielding procedures,and should be implemented on a case-by-case basis. Portable X-ray equipment is also utilized at sites remote from the testing lab. The use of X-rays requires a separate darkroom for developing exposed film.

Some bases are authorized to perform spectrometric oil analysis under the Joint Oil Analysis Program (JOAP). This testing procedure requires a special machine that burns oil samples to identify foreign material that may be present in the oil sample, and requires a gas vent flue. Locate the JOAP function in an administrative area, in a separate room.

2. Shop Equipment

Shop equipment includes fluorescent penetrate and magnetic particle testing machines, portable ultrasonic and eddy current machines, and X-ray and darkroom equipment.

3. Material Storage

Provide free-standing cabinets and drawers for NDI shop testing materials.

4. Special Equipment

An NDI lab requires a 1 ton capacity monorail with two 1/2 ton capacity hoists servicing both the X-ray shielded room and the room containing the fluorescent penetrate and magnetic particle testers. Provide silver recovery equipment in the darkroom.

5. Special Utility Services

Provide air conditioning for storage of X-ray film and operation of the oil analysis spectrometers. The NDI lab requires 150 psi shop air, corrosion resistant drains and 480 volt, 3 phase electricity.

Functional Space Requirements for the Nondestructive Inspection Shop[1]		
Functions	**Gross Area**	
	Square Feet	**Square Meters[2]**
Shop Administration	500	46
Exposure Room (X-Ray)	450	41
Film Processing Room	200	19
Control Room	40	4
Light Trap	10	1
Film Interpretation/File Room	200	19
Ultrasound	200	19
Work Room	200	19
Penetrant Magnetic Room	1,400	130
Spectrometric Oil Analysis	400	37
Support Areas[3]	400	37
TOTAL	4,000	372

Table 4-D: Functional Space Requirements for the Nondestructive Inspection Shop.

Legend for Table 4-D.
(1) Example based on 1 Air Mobility C-17 Wing.
(2) Square Meters = .0929 x Square Feet (All measurements are rounded).
(3) See Chapter 3, Section C, for description of Support Areas.

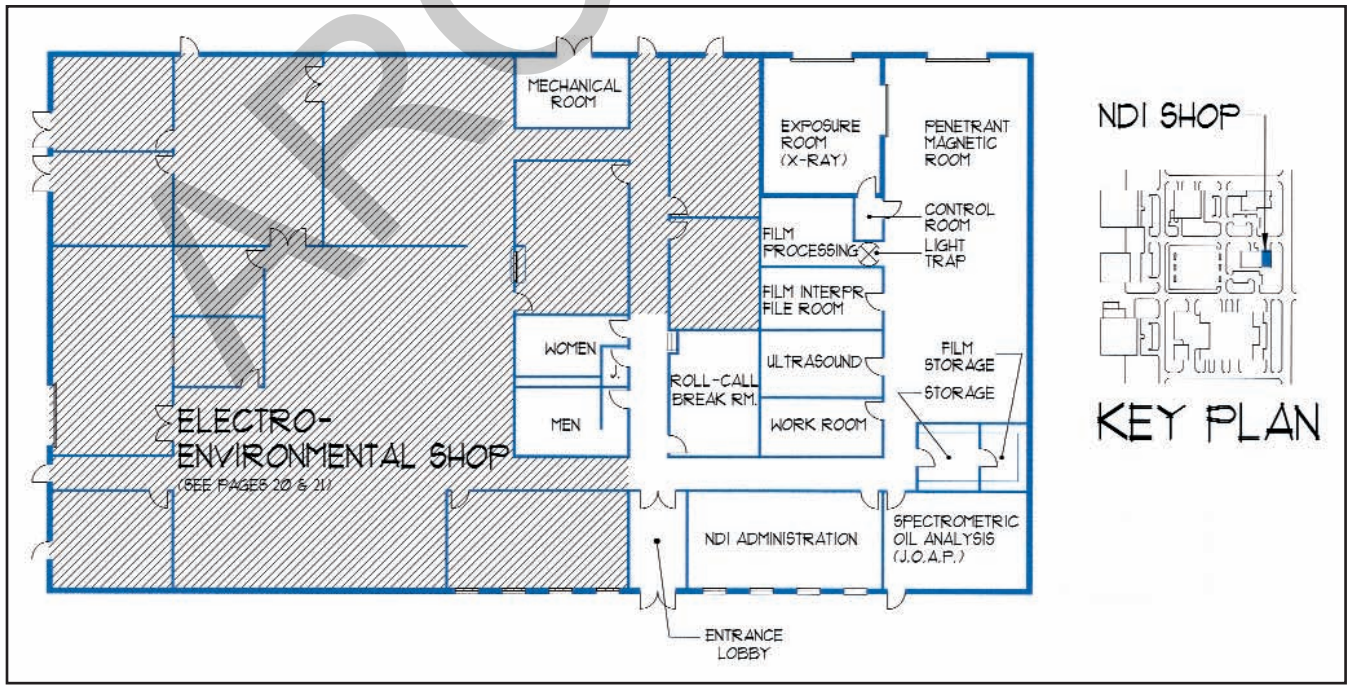


Figure 4-D: Concept Floor Plan for the Nondestructive Inspection Shop.

E. Electro-Environmental Shop

1. General

The electro-environmental (ELEN) flight maintains all of the electrical items (except avionics) and environmental items for personnel on an aircraft. The GOX/LOX/NIT servicing area will require a sound proof and explosion proof room for storage and maintenance of this equipment.

The wire maintenance function is performed within the ELEN shop to maintain and rebuild all of the wire harnesses contained within the aircraft. Provide an area large enough to permit effective use of the wiring harness make-up boards routinely employed in rebuilding and repairing wiring.

Testing and repair of electronic items is typically performed in a separate room on work benches lined with testing equipment. Furnish this room with task lighting and supply it with adequate electricity to support all test equipment.

Include a battery servicing room to recharge and perform minor maintenance on batteries. When both Ni-Cad and lead acid batteries are serviced, two separate rooms are necessary to prevent cross-contamination of fumes produced by the two battery types. The rooms may be adjacent if adequate precautions are taken to prevent cross-contamination. Both rooms require an emergency shower and eyewash station complete with an alarm system to notify other building occupants when the shower/eyewash system is activated. All equipment in the lead acid charging area must be explosion proof. Utility rooms enclosed in or accessed from the charging room are included in this requirement.

A sound-proof room is required to house the test stand equipment for generators and constant speed drive (CSD) equipment. This room requires penetration resistant walls to protect building occupants in case of catastrophic failure of the component being tested. Oxygen bottles and life raft bottles (carbon dioxide cartridges) are serviced in a separate area within the shop. Functions include weighing to determine charge status, valve replacement, and bottle recharge.

2. Shop Equipment

Shop equipment in the ELEN shop will include battery charging equipment for both Ni-Cad and lead acid batteries, electronic testing equipment, and servicing equipment for bottled gases.

3. Material Storage

Provide storage space for electronic equipment awaiting repair and/or pickup. Storage space is also required for serviceable batteries to be recharged and unserviceable batteries to be discarded.

4. Special Equipment

The wire maintenance area requires plywood wiring harness make-up boards for each type of wiring harness manufactured. Wire-dispensing cabinets provide both storage of wire spools, as well as, an efficient method of gathering the proper wire gauges and lengths for various harness.

The sound-proof room will contain the generator test equipment, and a 1/4 ton hoist to manipulate heavy components.

5. Special Utility Services

The ELEN shop requires 150 psi shop air and 480 volt, 3 phase electricity. The lead acid battery shop, and gaseous nitrogen and oxygen rooms, require light fixtures and electrical devices that are explosion proof.

Equip the lead acid battery shop with safety shower and eyewash.

Functional Space Requirements for the Electro-Environmental Shop[1]		
Functions	**Gross Area**	
	Square Feet	**Square Meters[2]**
Shop Administration	700	65
Electrical Shop Area	3,500	325
Generator/CSD Test Room	1,000	929
Control Room	200	19
Wire Maintenance Area	1,500	139
Environmental Shop Area	1,500	139
Gaseous Nitrogen Room	500	46
Oxygen Room	500	46
Lead Acid Battery Room	600	56
Ni-Cad Battery Room	500	46
Support Areas[3]	2,000	186
TOTAL	12,500	1,161

Table 4-E: Functional Space Requirements for the Electro-Environmental Shop.

Legend for Table 4-E.
(1) Example based on 1 Air Mobility C-17 Wing.
(2) Square Meters = .0929 x Square Feet (All measurements are rounded).
(3) See Chapter 3, Section C, for description of Support Areas.

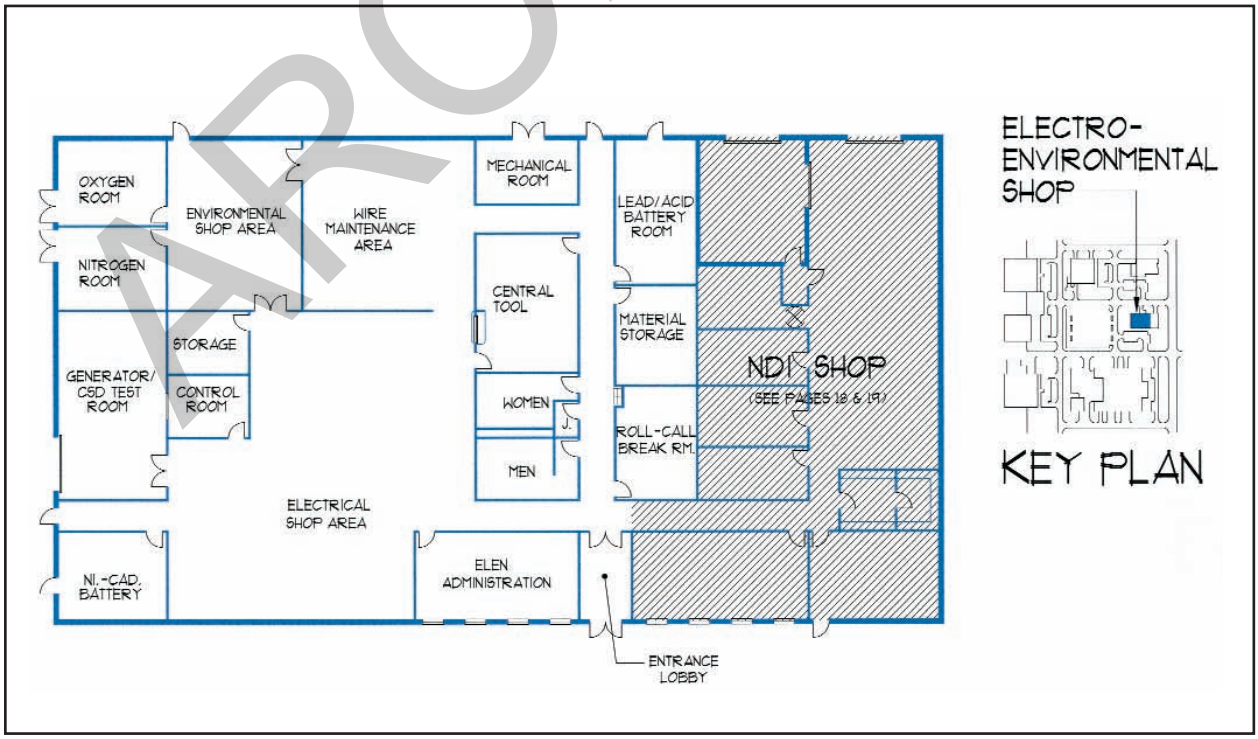


Figure 4-E: Concept Floor Plan for the Electro-Environmental Shop.

F. Survival Shop

1. *General*

Survival shop personnel maintain/repair parachutes, flotation equipment and manufacture fabric items.

2. *Shop Equipment*

The parachute section inspects and maintains personnel parachutes and, in some cases, deceleration/drone parachutes. Provide a parachute washing room, and drying tower, and a large room equipped with long tables for inspecting and repacking parachutes.

Include a flotation room for the inspection, inflation, and repacking rubberized survival equipment and accessories. Provide sufficient overhead clearance to permit an inflated raft to be turned over by the repair staff. Locate an adjacent room with specialized ventilation for using chemicals to glue rubberized items, repair anti-exposure suits, and clean parachute components.

Include compressed air for inflation of rafts in the flotation section.

The fabrication section consists of a sewing room with space for repair and manufacture of fabric, canvas, and leather survival equipment. At some installations, repair of flight suits, manufacture of aircraft insulation panels and other locally manufactured products is performed.

3. *Material Storage*

Parachutes awaiting inspection/repacking or pick-up for re-issuance are temporarily stored in this facility.

In the flotation section, cargo nets and survival kits require storage space awaiting inspection or pick-up for re-issuance. Flare inspection and repair requires a fire/explosion proof room.

Provide storage space in the fabrication section for fabric bolts and rolls utilized in the repair and manufacture of various items. This space must allow for easy retrieval of all the different fabrics required. A system of cubbyholes or drawers is needed to store flight suits awaiting repair or customer pick-up.

Provide electric extension cord reels in the fabrication section.

4. *Special Equipment*

Special equipment required in the survival shop includes parachute packing tables, heavy duty sewing machines, a parachute washing machine, and a vacuum system for deflating flotation devices.

5. *Special Utility Services*

The survival shop must maintain regulated temperature and humidity conditions, and 150 psi shop air and 480 volt, 3 phase electricity. The flare inspection & repair room requires explosion proof light fixtures and electrical devices.

Functional Space Requirements for the Survival Shop[1]		
Functions	Gross Area	
	Square Feet	Square Meters[2]
Shop Administration	800	74
Flight Clothing	200	19
Parachute Washing Room	400	37
Parachute Drying Tower	600	56
Parachute Packing Room	2,100	195
Fabrication Room	1,900	177
Cargo Net	400	37
Glue & Adhesive Room	200	19
Flotation Room	4,800	445
Survival Kit Inspection	500	47
Flare Inspection & Repair	100	9
Support Areas[3]	2,000	186
TOTAL	14,000	1,300

Table 4-F: Functional Space Requirements for the Survival Shop.

Legend for Table 4-F.
(1) Example based on 1 Air Mobility C-17 Wing.
(2) Square Meters = .0929 x Square Feet (All measurements are rounded).
(3) See Chapter 3, Section C, for description of Support Areas.

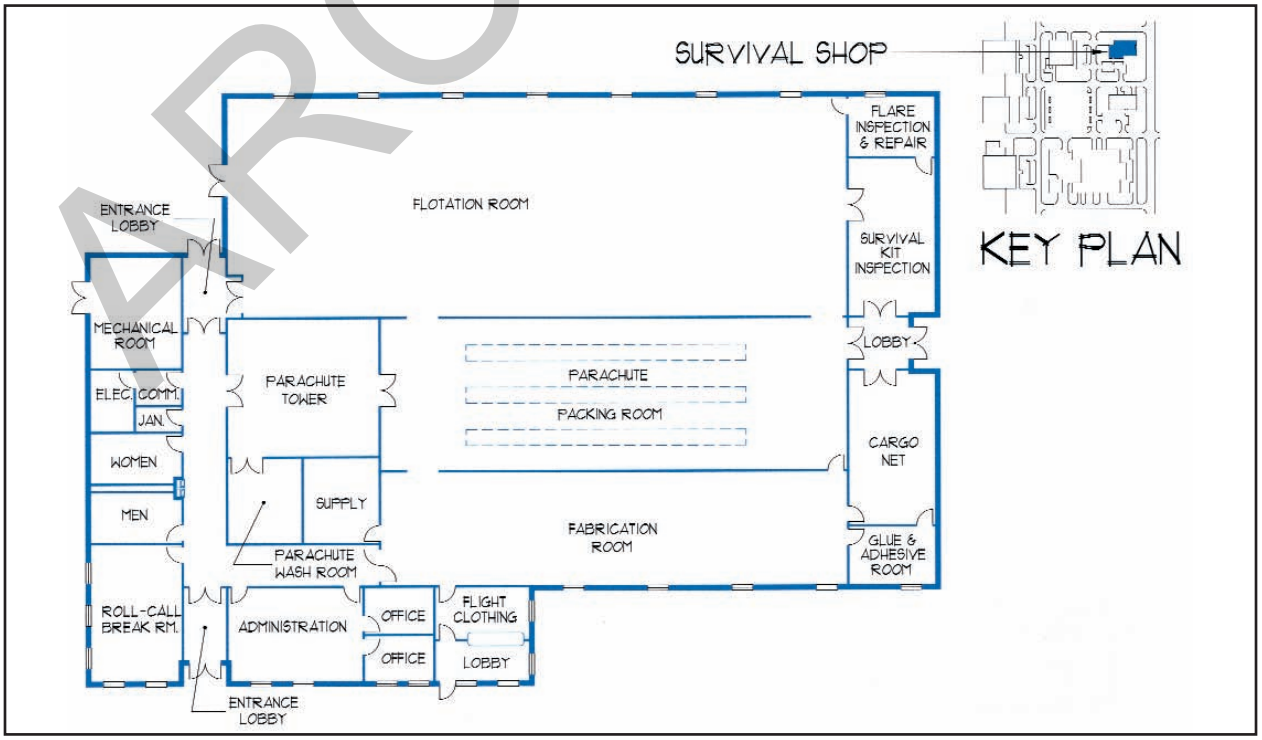


Figure 4-F: Concept Floor Plan for the Survival Shop.

G. Pneudraulics Shop

1. General

The pneudraulics shop provides repair and manufacture of aircraft components related to pneumatic and hydraulic systems. Design rooms to accommodate large components such as a KC 135 refueling boom, or shop equipment such as tube benders.

2. Shop Equipment

Shop equipment includes hose cutting and fitting machines, a landing gear test stand for specific aircraft, a self-contained parts cleaning system (jet washer) with non-foaming detergent, and a hydraulic test stand for performance evaluation of hydraulic components. Certain shop equipment, such as the "jet washer" will require a sound proof room.

The hydraulic test stand requires a separate room large enough to allow proper access to the equipment. This room must be sound proof, explosion proof, and include windows for visibility, emergency eye wash and shower stations, and alarm systems.

3. Material Storage

This shop requires storage for various types and sizes of hydraulic tubing. Ideal storage containers for tubing are multiple PVC pipes, each approximately 20 feet long and 4 inches in diameter, with caps on each end. Provide secure storage area for equipment and components that are, due in for maintenance (DIFM). Provide for other storage requirements through the use of the bench stock and tool bin areas.

4. Special Equipment

Install a 1 ton bridge crane or monorail servicing the majority of the work area and 1/4 ton jib cranes at strategic locations for material handling. Work tables require different top surfaces depending on the component being repaired. Provide easily cleaned aluminum work surfaces for handling parts containing hydraulic fluid. Use vinyl covered work surfaces to help protect delicate components.

5. Special Utility Services

The pneudraulics shop requires 150 psi shop air and 480 volt, 3 phase electricity.

The C-5 landing gear test stand requires a high bay for maintenance and testing activities.

Functional Space Requirements for the Pneudraulics Shop[1]		
Functions	Gross Area	
	Square Feet	Square Meters[2]
Shop Administration	150	14
DIFM/Stage Storage	600	56
General Shop	2,700	250
Hydraulic/Pneumatic Testing	2,300	214
Support Areas[3]	1,750	163
TOTAL	7,500	697

Table 4-G: Functional Space Requirements for the Pneudraulics Shop.

Legend for Table 4-G.
(1) Example based on 1 Air Mobility C-17 Wing.
(2) Square Meters = .0929 x Square Feet (All measurements are rounded).
(3) See Chapter 3, Section C, for description of Support Areas.

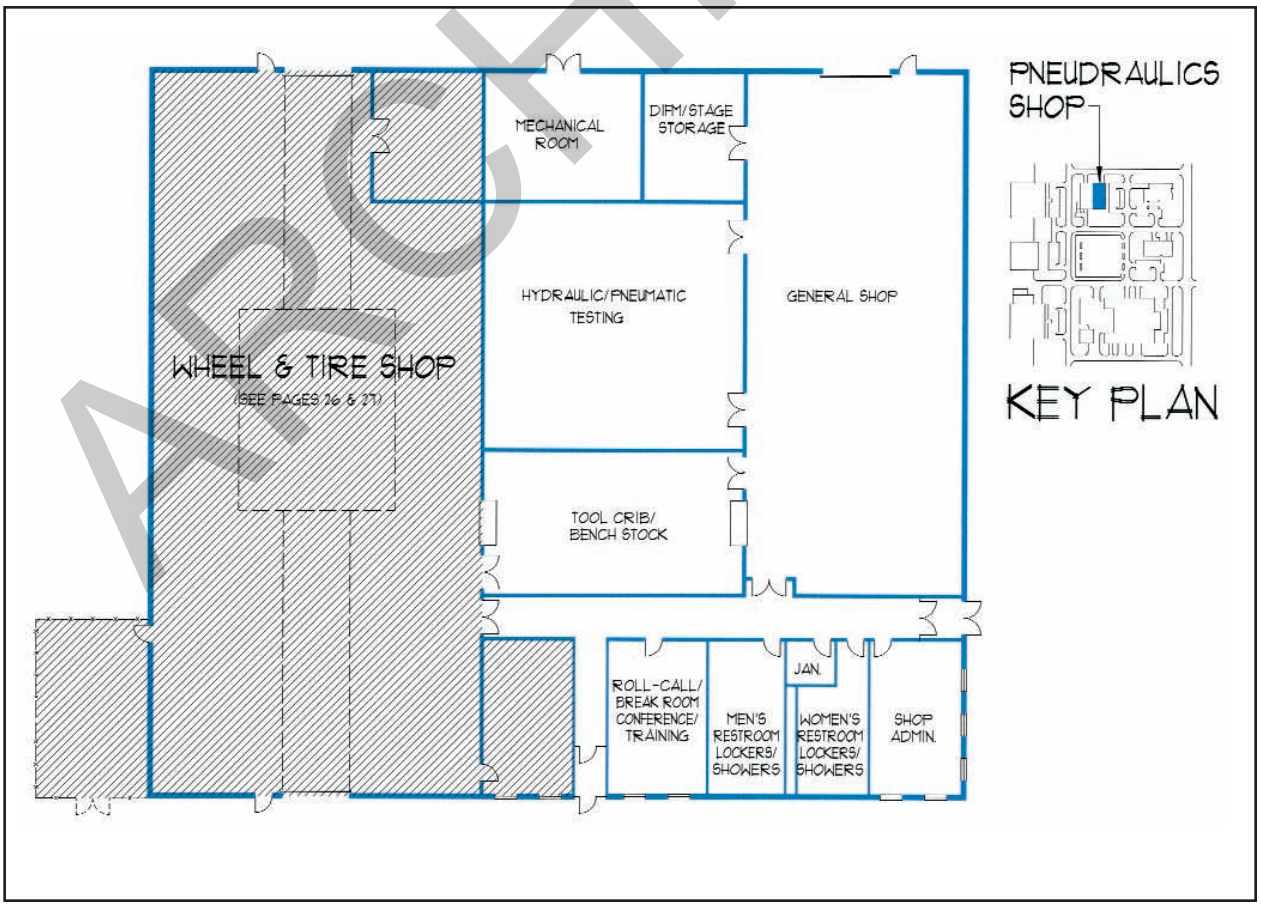


Figure 4-G: Concept Floor Plan for the Pneudraulics Shop.

H. Wheel and Tire Shop

1. General

Wheel and tire shop personnel provide replacement tire service for all aircraft types located at any particular base. They receive tires and wheels from the flightline, remove the old tires; clean, inspect, and repaint the old wheels; clean, inspect, repair, and repack the associated bearings; and install new tires on the refurbished wheels.

Provide a hard rubber floor coating in the tire break-down/assembly area to avoid damage to the wheels during operations performed in the shop. A seamless floor coating will keep fluid spills from seeping through cracks and creating maintenance problems. Provide walls and ceilings with appropriate sound insulation to reduce noise.

Wheel bearings require inspection and repacking when tires are replaced. The bearing/solvent room contains a jet washer, with non-foaming detergent, for cleaning bearings. Provide and equip an area suitable for repacking the bearings with lubricant and wrapping them in appropriate paper.

2. Shop Equipment

Shop equipment in the wheel and tire shop includes large tire break-down machines, tire inflation cages, an oven for heating wheels, a freezer for cooling bearing races, an arbor press, and a jet washer.

3. Material Storage

Material storage includes wheel and tire assemblies awaiting service and repair or pick-up. Provide storage racks sufficient for this requirement. Use automated vertical storage to free up floor space.

4. Special Equipment

Provide a 1/4 ton monorail hoist for moving large wheels.

5. Special Utility Services

The wheel and tire shop requires 150 psi shop air and 480 volt, 3 phase electricity. It also requires corrosion resistant floor drains.

The wheel and tire shop includes a parts washer, an overhead monorail, storage racks, a tire inflation cage and hard rubber flooring.

Functional Space Requirements for the Wheel and Tire Shop[1]		
Functions	**Gross Area**	
	Square Feet	**Square Meters[2]**
Shop Administration	300	28
Tire Breakdown/Assembly Area	2,100	196
Incoming Wheel and Tire Storage	1,900	176
Outgoing Wheel and Tire Storage	1,900	176
Bearing/Solvent Room	300	28
Support Areas[3]	1,000	93
TOTAL	7,500	697

Table 4-H: Functional Space Requirements for the Wheel and Tire Shop.

Legend for Table 4-H.
(1) Example based on 1 Air Mobility C-17 Wing.
(2) Square Meters = .0929 x Square Feet (All measurements are rounded).
(3) See Chapter 3, Section C, for description of Support Areas.

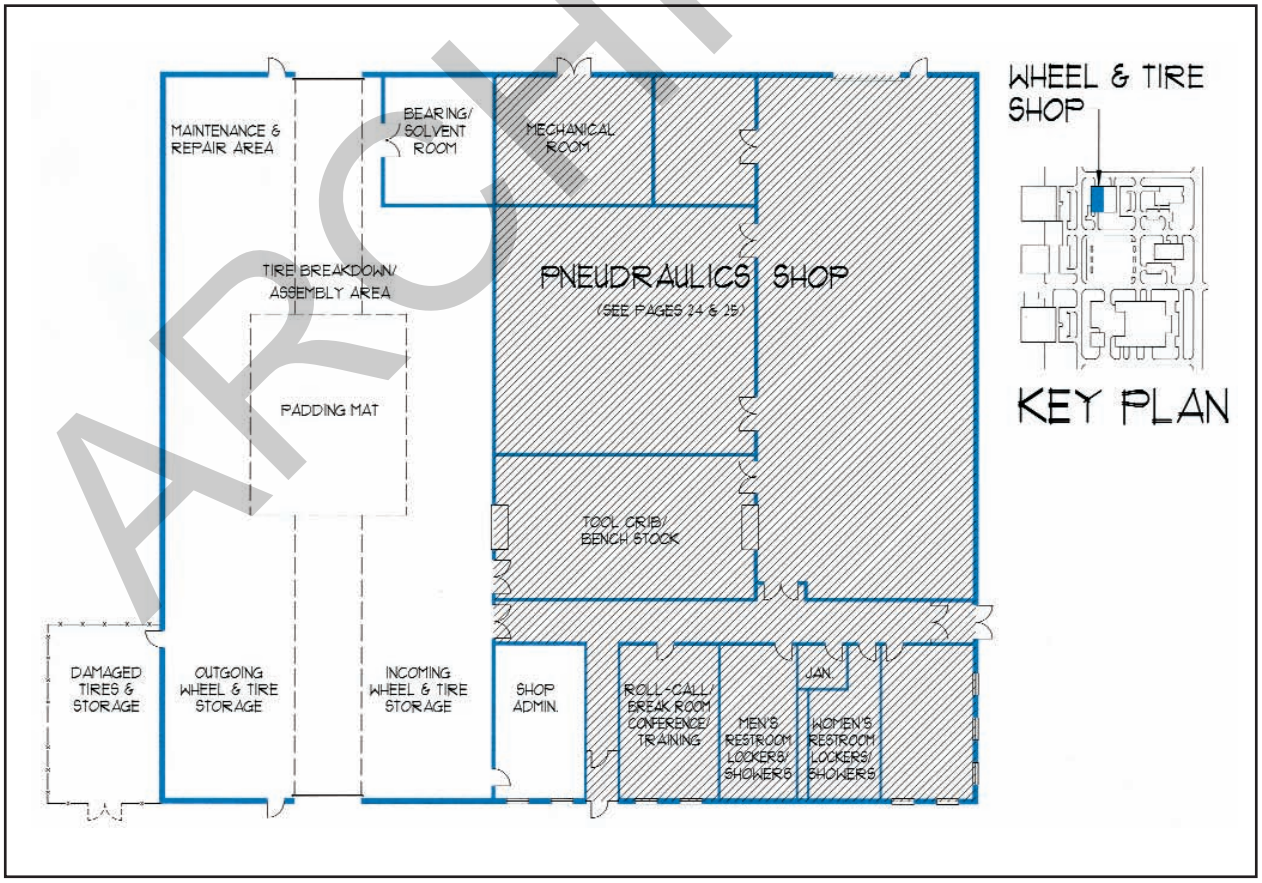


Figure 4-H: Concept Floor Plan for the Wheel and Tire Shop.

I. Aero Repair/Crash Recovery Shop

1. General

The aero repair/crash recovery (A/R) element removes and replaces large parts and/or pieces from aircraft and recovers aircraft in the event of a crash. After a part or piece is removed from the aircraft, this element transports it to the proper repair facility then returns it or a replacement to the aircraft and reinstalls it.

2. Shop Equipment

Provide access to a test stand for aircraft jacks and to a 3 ton hoist for disassembling struts. The hoist can be in either the A/R facility or nearby.

3. Material Storage

Provide a paved area adjacent to the facility for the parking of transportation trailers and other heavy equipment. In extreme cold climates provide indoor, heated storage.

4. Special Equipment

The A/R shop contains equipment for transporting various aircraft parts from the aircraft to the repair facility and back again. This equipment is most often in the form of specialized trailers but aircraft jacks are also part of the required equipment.

5. Special Utility Services

The A/R shop requires 150 psi shop air and 480 volt, 3 phase electricity.

Functional Space Requirements for the Aero Repair/Crash Recovery Shop[1]

Functions	Gross Area	
	Square Feet	Square Meters[2]
Shop Administration	200	18
Support Equipment & Shop Areas	4,000	372
Support Areas[3]	1,800	167
TOTAL	6,000	557

Table 4-I: Functional Space Requirements for the Aero Repair/Crash Recovery Shop.

Legend for Table 4-I.
(1) Example based on 1 Air Mobility C-17 Wing.
(2) Square Meters = .0929 x Square Feet (All measurements are rounded).
(3) See Chapter 3, Section C, for description of Support Areas.

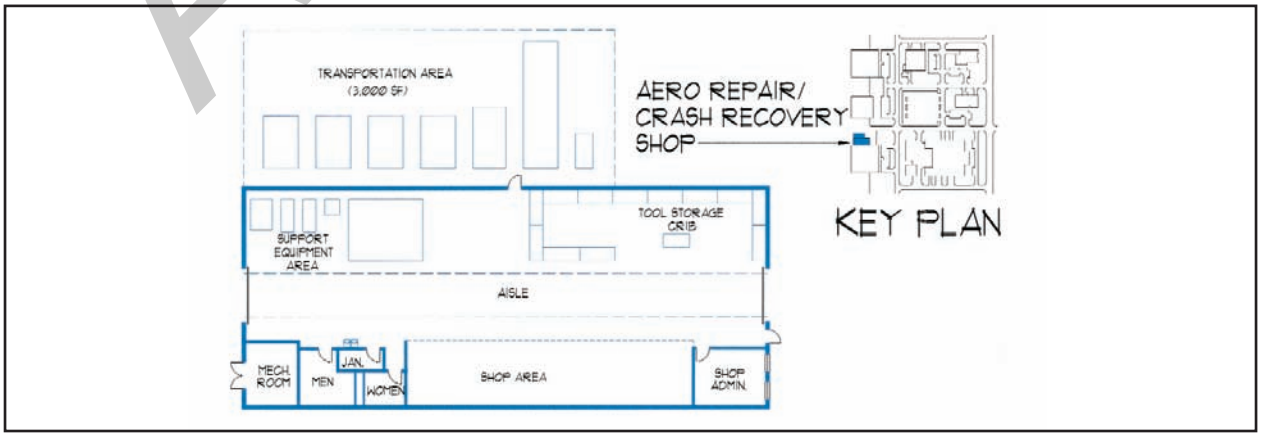


Figure 4-I: Concept Floor Plan for the Aero Repair/Crash Recovery Shop.

Chapter 5

AME -21 Functional Areas

A. General

This chapter presents criteria for designing areas which are contained in the AME -21 function of the AISF. Design considerations are given to indicate the use and basic requirements of each functional area. Equipment, storage, and special utility requirements are also discussed. These recommendations may be modified to reflect mission requirements.

These shops provide facilities for inspecting, repairing, servicing, and storing alternate mission equipment. This includes passenger seats for airbus configuration, jump seats for airborne troop deployments, wind breaks and jump platforms, cargo rails, winches, emergency lighting, and comfort (and other type) pallets. AME -21 operations occur 24 hours per day, seven days a week. Space requirements for AME -21 facilities are determined on a case-by-case basis, depending on aircraft type serviced, number of squadrons, and mission types supported.

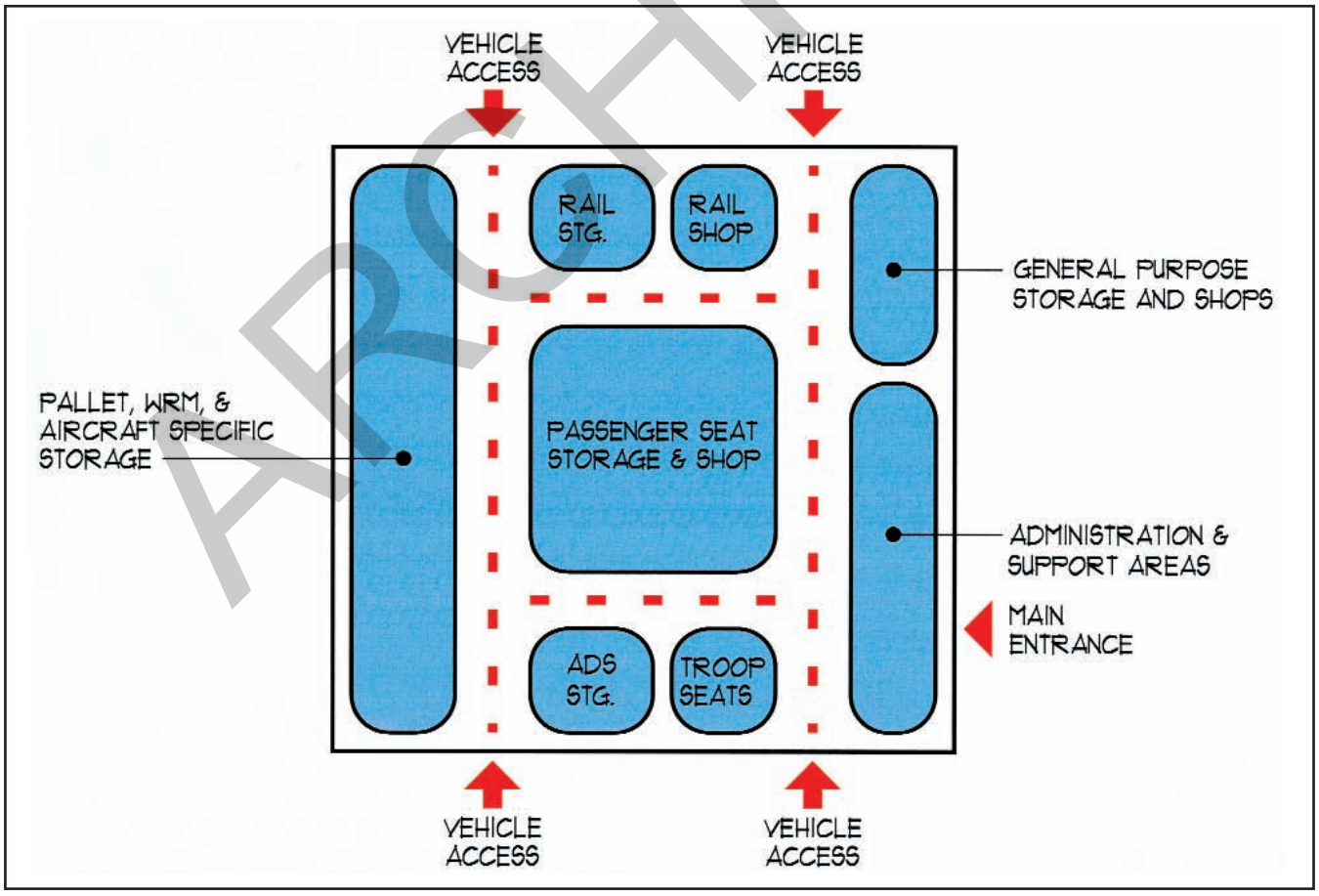


Figure 5-A: AME -21 Functional Area Relationships.

B. Shop Administration Areas

1. General

Provide a drive-through configuration where trucks can be easily loaded and unloaded.

Provide a centrally located dispatch and library room to monitor all aircraft, equipment, and personnel. It should accommodate all administrative staff on the largest shift.

2. Administration Area Equipment

Equipment in the dispatch and library room will generally be standard office-type equipment which includes computers, telephones, and a fax machine.

3. Material Storage

Provide storage space for all AME -21 technical manuals for each aircraft type assigned to the base.

4. Special Equipment

Special equipment required in the dispatch and library room includes a base radio and aircraft and personnel status boards.

5. Special Utility Services

Provide standard utilities necessary to support a typical administrative area environment.

C. Equipment Maintenance Areas

1. General

These shops are visual inspection, removal and repair shops. Provide anti-fatigue mats at all work areas where personnel stand for extended periods of time. In extreme climates, provide plastic strip doors and/or air curtains at overhead doors. Size overhead doors to permit large pieces of equipment and forklifts to enter the building.

Provide floor space and work benches for maintenance of passenger and troop seats. Depending on specific configuration, maintenance can be performed at one end of a seat pallet storage platform.

Provide adequate clearance for work benches and wheeled storage racks in the rail maintenance shop.

Furnish the troop (red) seat maintenance shop with work benches and storage cabinets.

Maintenance of cargo rails is performed in a room dedicated to that purpose. Naphtha and MEK solvents used to clean the rails require special ventilation. Incorporate a drive through configuration when rail trailers are used. Maintenance is performed on various winch types used in aircraft assigned to the base. Winch cable inspection and replacement requires a 300 foot long runout area. A series of pulleys will shorten this distance considerably but the cable must not be coiled under any circumstance. Include additional space for maintenance and testing of personnel warning lights.

2. Shop Equipment

Provide for hand and pneumatically driven power tools in the AME -21 maintenance shops.

3. Material Storage

Material storage in the AME -21 maintenance shops is, generally, limited to small bench stock items.

4. Special Equipment

Use pneumatically driven power tools in the rail maintenance shop to reduce sparking hazard. Also, provide a work bench with a notched work surface which allows both sides of the rails to be accessed at the same time. Install tool compartments below the work surface.

Provide an overhead crane or use portable hoist to manipulate the winches during the repair process. Provide a workbench within the winch maintenance area for servicing personnel warning lights. Include bench stock below and an electrical testing board mounted on the wall above the work bench.

5. Special Utility Services

The AME -21 maintenance shop requires 150 psi shop air and 208/120 volt, 3 phase electricity. Some industrial equipment may require 480 volt, 3 phase electricity. Supply a minimum of one electric and one pneumatic drop per work bench. Provide an exhaust system for the removal of fumes produced in the process of cleaning rails. Locate floor drains in areas where vehicles may have access. Connect all floor drains to an oil/water separator.

D. Equipment Storage Areas

1. General

Contact Air Force Material Command (AFMC) for additional guidance and information pertaining to material handling systems.

Depending on the types of aircraft assigned to the base, two types of seats are stored in this facility: passenger seats (blue seats), similar to commercial airline seats, and sling type troop seats (red seats). Space requirements for storage depend on the type and number of aircraft assigned to the base. If the blue seats are mounted on pallets, provide a raised platform or racking system to permit more efficient storage. When an elevated platform method is used, the space under the platform can be used for war readiness material (WRM) storage. Red seats are folded and stored in a series of wall cabinets or shelves.

A typical truck bed height storage platform.

Work flow is an important design consideration for cargo rail storage. When rails are stored on trailers, provide a drive through configuration.

An example of cargo rail and winch storage racks.

Winch storage requirements are determined by the type and number of aircraft served. Provide a portable hoist to move and store these winches.

Provide storage and maintenance space for conference room, sleeping room, comfort, galley and other specialized pallets.

Provide quality lighting for comfort pallet maintenance.

2. Shop Equipment

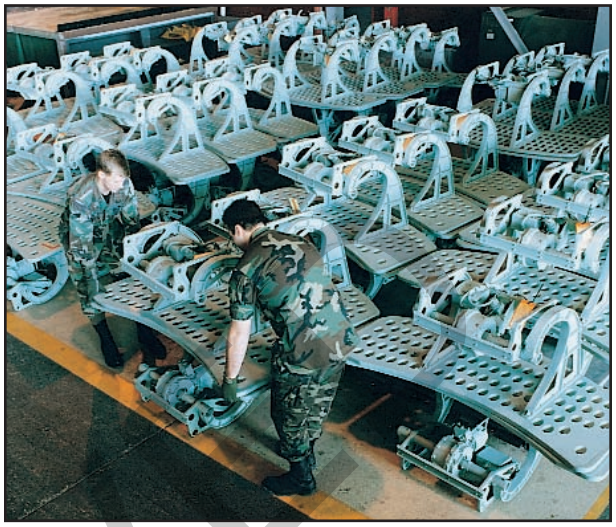
Allocate space for shop equipment required by AME -21 operations.

3. Material Storage

Utilize industrial shelving and high density storage systems to maximize the use of available space. Allow ample clearances for maneuverability. Clearly label and identify storage areas to facilitate the selection of parts.

Design the loading dock to accommodate truck bed height and permit direct drive-in access.

E. Aircraft Specific Parts Storage



Provide adequate floor area for storage of air drop spoiler doors.

1. *C-5*
   - Bench Stock
   - Winch storage
   - Parachute spoiler doors and jump platforms
   - ADS Kits
   - Airbus seat storage rack 20'x60'x20'high contains 54 pallets of 10 seats

2. *C-17*
   - Bench Stock
   - Test Equipment for rail locks
   - Armor plate storage bins (one per aircraft 4'x4'x4')
   - Distinguished Visitors Material Storage (four aircrafts require 15' x 4')

3. *KC-135*
   - Bench Stock
   - Drogue Storage
   - Wall mounted panel cutter
   - Storage for plywood luggage bins
   - Storage for equipment that is taken off of the aircraft when it goes to depot (6'x6' per aircraft)
   - Escape Slides
   - Protective Engine Covers

Space Requirements Per Assigned Aircraft Squadron[1]						
Mission Type	Gross Area[2]					
	C-5		C-17[3]		KC-135	
	SF	SM	SF	SM	SF	SM
2 or Less Squadrons	7,500	697	1,850	172	4,000	372
3 or More Squadrons	5,600	520	1,375	128	3,000	279
Gross Square Footage Calculation Example						
Assume: 4 assigned C-5 Aircraft Squadrons (1 Wing) Example: 4 C-5 Squadrons x 5,600 SF/Squadron = 22,400 SF (2,080 SM)						

Table 5-A: Space Requirements per Assigned Aircraft Squadron.

Functional Space Requirements for Administration Area[4][5]						
Mission Type	Net Area					
	C-5		C-17		KC-135	
	SF	SM	SF	SM	SF	SM
NCOIC/OIC's Office	150	14	150	14	150	14
Dispatch	150	14	150	14	150	14
Administration	300	28	200	19	200	19
Training/Conference Room/Library	200	19	150	14	150	14
Roll-Call/Break Room	200	19	150	14	150	14
Subtotal	1,000	93	800	75	800	75

Table 5-B: Functional Space Requirements for Administration Area.

Functional Space Requirements for Support Area[4][5]						
Mission Type	Net Area					
	C-5		C-17		KC-135	
	SF	SM	SF	SM	SF	SM
Rest Rooms/Lockers/Showers	650	60	500	46	500	46
Janitor's Closet	40	4	40	4	40	4
Mechanical Room	200	19	150	14	150	14
Electrical Room	70	7	70	7	70	7
Communications Room	40	4	40	4	40	4
Subtotal	1,000	93	800	75	800	75

Table 5-C: Functional Space Requirements for Support Area.

Functional Space Requirements for Equipment Maintenance Areas[4]						
Mission Type	Net Area					
	C-5		C-17		KC-135	
	SF	SM	SF	SM	SF	SM
Tool Crib/Bench Stock	500	46	700	65	500	46
Passenger Seat Shop	1,400	130	100	9	150	14
Troop Seat Shop	300	28	100	9	150	14
Cargo Rail Shop	1,100	103	400	37	100	9
General Purpose Shop	700	65	400	37	700	65
Subtotal	4,000	372	1,700	158	1,700	158

Table 5-D: Functional Space Requirements for Equipment Maintenance Areas.

Functional Space Requirements for Equipment Storage Areas[4]						
Mission Type	Net Area					
	C-5		C-17		KC-135	
	SF	SM	SF	SM	SF	SM
Passenger Seat Storage	2,500	232	100	9	400	37
Troop Seat Storage	600	56	100	9	200	19
Cargo Rail Storage	1,000	93	600	56	100	9
General Purpose/Aircraft Specific Storage	8,500	790	700	65	6,000	557
Subtotal	12,600	1,171	1,500	139	6,700	622

Table 5-E: Functional Space Requirements for Equipment Storage Areas.

Functional Space Requirements for Alternate Mission Equipment (AME -21)[4]						
Mission Type	Net Area					
	C-5		C-17[3]		KC-135	
Function	SF	SM	SF	SM	SF	SM
Administration Area (See Table 5-B)	1,000	93	800	75	800	75
Support Area (See Table 5-C)	1,000	93	800	75	800	75
Equipment Maintenance Areas (See Table 5-D)	4,000	372	1,700	158	1,700	158
Equipment Storage Area (See Table 5-E)	12,600	1,171	1,500	139	6,700	622
Subtotal	18,600	1,727	4,600	427	10,000	929
Walls and Circulation (Approximately 20%)	3,800	353	900	84	2,000	186
TOTAL AME -21 Facility	22,400	2,080	5,500	511	12,000	1,115

Table 5-F: Functional Space Requirements for AME -21.

Legend for Tables 5-A through 5-F.

SF = Square Feet SM = Square Meters = .0929 x SF (All measurements are rounded).

(1) 1 Squadron = 12 Aircraft. Minimum space requirements are listed.

(2) Areas may be adjusted to meet specific base and mission requirements.

(3) Gross Area for C-17 is based on Aircraft Manufacturer's Recommendation.

(4) Areas are based on 1 Wing (4 Squadrons).

(5) See Chapter 3 for description of Administration and Support Areas.

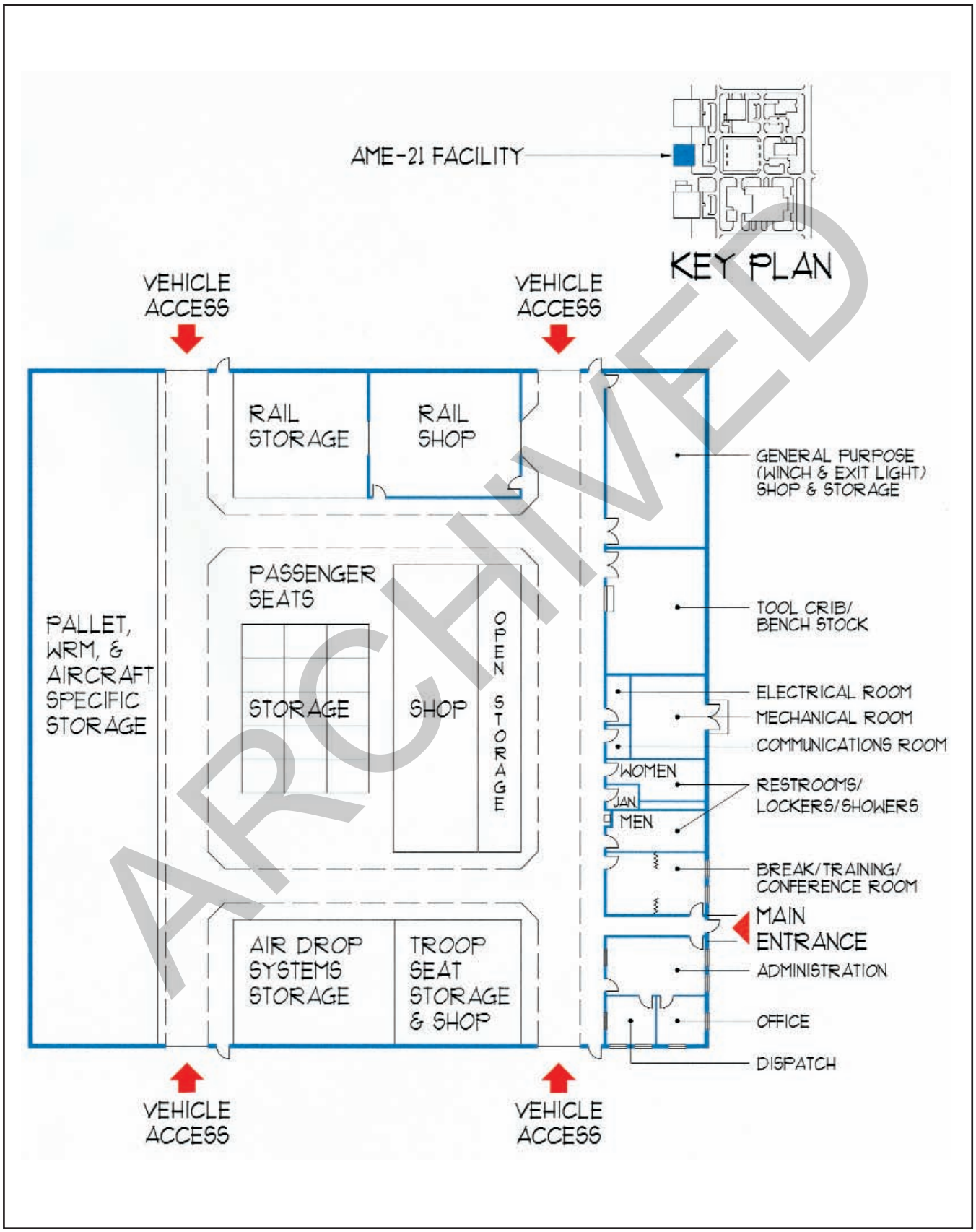


Figure 5-B: Concept Floor Plan for the Alternate Mission Equipment -21 Facility.

Chapter 6

Interior Standards

A. General

Quality interiors create an environment which improves job performance, conveys professionalism, and maintains security and safety in the workplace. Use qualified professional interior design services to establish and coordinate finish materials and furnishings. Select finishes for anticipated use, durability, life cycle maintenance, cost effectiveness, fire and life safety requirements, and appearance.

B. Finishes

1. Administrative Areas

Design administrative areas to resemble a typical office environment. Consider carpet tile for high-use areas such as corridors, waiting areas, and training rooms. Avoid stripes and linear designs that are hard to line up with walls in corridors, vestibules, or irregularly shaped areas. Select multi-colored or solid color carpet in darker shades for offices and roll call/break rooms. Use vinyl and/or acoustic wallcovering, paint finishes, and special coating for ease of maintenance and to present a less institutional appearance. Use suspended acoustical ceiling tile with a revealed edge finish in the administration areas. A standardized 2' x 2' tile is recommended as the consistent module throughout the facility.

2. Maintenance Areas

Finishes within the maintenance and storage areas are constantly subject to traffic, cleaning and abrasion. Floor finishes may require a slip/chemical resistant coating system. Use concrete block walls for impact resistance and massing to reduce sound transmission. Hollow metal doors should be used for durability. Exposed roof structure is desired to maximize overhead clearance above the maintenance bays. It should be painted white, or other light color to increase light reflectance.

3. Support Areas

In personnel support areas, select materials which promote cleanliness and ease of maintenance. Use ceramic wall tile in rest rooms. Painted concrete block and metal siding are suitable finishes in the shop and storage areas. A water-resistant gypsum board ceiling works well with water-resistant paint finishes in rest rooms. Painted exposed roof structure is adequate in the shop and storage areas.

Industrial area with clean, light colored painted surfaces and quality lighting provides an ideal work environment.

Provide adequate clearance between parachute tables.

C. Color Concepts

Designers should give special attention to color selection and provide a timeless color scheme. Use accent colors sparingly to complement a neutral color scheme.

Select neutral colors for industrial flooring, carpets, wallcoverings, and systems furniture wall panels. Incorporate accent colors in upholstery, graphics, borders, accessories, and artwork for design scheme consistency.

D. Specialties/Accessories

In the administration areas, vertical blinds and mini-blinds filter daylight and allow outdoor views. Use lined draperies to block daylight in the conference and operations/training rooms for visual presentations. These rooms can be divided into multiple rooms with fabric covered acoustical rated, operable partitions.

In the administrative areas, framed artwork, wall murals, and live or professional quality silk plants complement the interior finishes and reinforce the design scheme. Choose only professionally framed pictures, paintings, and awards that contribute to the facility's decor. Provide space for a display case for awards, trophies, and other forms of recognition.

Develop an interior sign plan as part of the comprehensive interior design. See AFM 91-201, Explosives Safety Standards, to determine if fire symbol signs are required on the inside of the building. Use professionally made signs, appropriately sized for the viewing distance, and compatible with the facility design scheme.

Systems furniture includes interchangeable wall panels, panel hung desks, and storage modules which are combined to form office work stations. These stations allow for a reconfiguration of office areas. Use systems furniture that easily integrates computer hardware.

Systems furniture should incorporate integrated electrical and communications service to hide unsightly wires and cables. Sound absorbent fabric panels will reduce background noise and provide a quiet work area. Finish work surfaces in plastic laminate or wood.

Use systems furniture in all staff offices, except the commander's area. Integrate systems and free standing furniture during comprehensive interior design development.

Modular systems furniture offers flexibility for administrative areas.

E. Building Systems

1. Structural

Select a cost effective framing system based on size, project requirements, availability of materials, and local labor. Factors to consider when designing a structural building system include:

- Facility size and type
- Soil conditions
- Imposed conditions such as wind, snow, and seismic loads
- Clear span distance and clear height requirements
- Special equipment loading

2. Mechanical

Design all heating ventilation, and air conditioning (HVAC) to comply with the ASHRAE, Handbooks and ACGIH, Industrial Ventilation, A Manual of Recommended Practice.

Perform a life-cycle cost analysis of available energy sources, including consideration of passive solar design applications. Design the facility to meet federal energy conservation standards defined in 10 CFR (Code of Federal Regulations) Energy Conservation Voluntary Performance Standards for New Buildings.

Provide mechanical air circulation at all areas. Introduce outside fresh air at rates specified by code. Where authorized, provide air conditioning in the administrative areas. Provide zone controls to maintain different environmental conditions in all functional areas. Include hook-ups for the base energy monitoring and control system (EMCS).

3. Fire Protection

Provide a fire protection system in accordance with MIL-HDBK 1008B. Install an automatic sprinkler system through-out the facility, except in the mechanical room. In addition, a fire detection and alarm system is also required. Furnish fire extinguishers per NFPA 10. Construct facilities out of noncombustible construction. Contain hazardous or combustible supplies within a fire-rated enclosure.

4. Lighting

Natural and artificial lighting are important factors in creating a quality and productive environment. Lighting affects the perception of space, as well as the color of interior finishes. Design lighting to enhance the design scheme. Provide lighting intensities in accordance with the Illuminating Engineering Society (IES) Lighting Handbooks.

Use energy efficient light fixtures throughout the facility. Avoid the use of incandescent lighting due to its inefficiency and frequency of maintenance. Provide fluorescent lighting for general illumination of administrative and support areas. Use metal-halide lighting in interior service and maintenance areas. Include control systems to provide flexibility of lighting levels.

Consider natural lighting as a supplement to artificial lighting whenever possible. Windows and clerestories are preferred types of natural lighting elements. Due to maintenance and weather tightness factors, avoid the use of skylights. Some areas that benefit from natural lighting include the entrance, lobby, office areas, and service bays.

F. Communications

Provide telephone and computer wiring to support voice, data, security, and fire detection/alarm systems. Equip the facility with the capability for on-base and off-base phone lines, facsimile lines, intercom, public address system, and local area network (LAN).

The designer should contact the base civil engineer and the base communications unit for specific and/or additional requirements before undertaking major building upgrades or modifications. Incorporate these internal and external requirements in building design and modification specifications.

	FLOORS						BASE			WALLS			CEILING		
	Carpet	*Vinyl Composition Tile*	*Ceramic Tile*	*Ceramic Paver Tile*	*Sealed Concrete*	*Slip/Chemical Resistant Coating*	*Vinyl*	*Ceramic Tile*	*Ceramic Paver Tile*	*Coved Coating*	*Painted Gypsum Board*	*Vinyl Wallcovering*	*Painted Concrete Block*	*Ceramic Tile*	*Acoustical Ceiling Tile*	*Painted Gypsum Board*	*Painted Exposed Structure*
Administration Area:																	
Entrance/Lobby		◆		◆			◆				◆			◆			
Reception/Waiting Area	◆						◆				◆			◆			
Commander's Office	◆						◆				◆			◆			
Staff Offices	◆						◆				◆			◆			
Shop Administration/Offices		◆					◆					◆		◆			
A.R.T. Office	◆						◆				◆			◆			
Roll-Call/Break Room		◆					◆			◆				◆			
Conference Room	◆						◆				◆			◆			
Training Room	◆						◆				◆			◆			
Support Areas:																	
Tool Crib/Bench Stock					◆							◆					◆
T.O. Library		◆								◆				◆			
Material Storage Areas					◆							◆					◆
Rest Rooms/Locker Rooms			◆					◆					◆			◆	
Janitor's Closet					◆							◆				◆	
Mechanical Rooms					◆							◆					◆
Electrical/Communication Room					◆							◆					◆

Table 6-A: Finish Schedule for Administration and Support Areas.

	FLOORS							BASE			WALLS				CEILING		
	Carpet	*Vinyl Composition Tile*	*Ceramic Tile*	*Ceramic Paver Tile*	*Sealed Concrete*	*Slip/Chemical Resistant Coating*	*Vinyl*	*Ceramic Tile*	*Ceramic Paver Tile*	*Coved Coating*	*Painted Gypsum Board*	*Vinyl Wallcovering*	*Painted Concrete Block*	*Ceramic Tile*	*Acoustical Ceiling Tile*	*Painted Gypsum Board*	*Painted Exposed Structure*
Metals Technology Shop:																	
Machine Shop						◆			◆			◆					◆
CAD/CAM Room		◆					◆			◆				◆			
Welding Shop						◆			◆			◆					◆
Structural Maintenance Shop:																	
Sheet Metal Shop						◆			◆			◆					◆
Corrosion Control Shop						◆			◆			◆					◆
Fiberglass/Composites Shop						◆			◆			◆					◆
Nondestructive Inspection Shop	See T.O. 33B-1-1.																
Electro-Environmental Shop																	
Electrical Shop Areas					◆					◆				◆			
Battery Servicing Rooms						◆			◆			◆					◆
Generator/CSD Test Room						◆			◆			◆					◆
Environmental Shop Areas					◆					◆				◆			
Survival Shop																	
Flight Clothing		◆					◆			◆				◆			
Parachute Washing Room						◆			◆			◆					◆
Parachute Drying Tower						◆			◆			◆					◆
Parachute Packing Room		◆					◆			◆				◆			
Fabrication Room		◆					◆			◆				◆			
Cargo Net		◆					◆			◆				◆			
Glue and Adhesive Room		◆					◆			◆				◆			
Flotation Room		◆					◆			◆				◆			
Survival Kit Inspection		◆					◆			◆				◆			
Flare Inspection and Repair		◆					◆					◆					◆
Pneudraulics Shop																	
General Shop						◆			◆			◆					◆
Hydraulic/Pneumatic Testing						◆			◆			◆					◆
Wheel and Tire Shop																	
Breakdown/Assembly Area					◆							◆					◆
Bearing/Solvent Room						◆				◆	◆						◆
Aero Repair/Crash Recovery						◆			◆			◆					◆

Table 6-B: Finish Schedule for Aircraft Maintenance Shops Functional Areas.

	FLOORS						BASE			WALLS			CEILING	
	Carpet	*Vinyl Composition Tile*	*Ceramic Tile*	*Ceramic Paver Tile*	*Sealed Concrete*	*Slip/Chemical Resistant Coating*	*Vinyl*	*Ceramic Tile*	*Ceramic Paver Tile*	*Coved Coating*	*Painted Gypsum Board*	*Vinyl Wallcovering*	*Painted Concrete Block*	*Ceramic Tile*	*Acoustical Ceiling Tile*	*Painted Gypsum Board*	*Painted Exposed Structure*
Equipment Maintenance Areas:																	
Passenger Seat Shop				◆								◆				◆	
Troop Seat Shop				◆								◆				◆	
Cargo Rail Shop				◆								◆				◆	
General Purpose Shop				◆								◆				◆	
Equipment Storage Areas:																	
Passenger Seat Storage				◆								◆				◆	
Troop Seat Storage				◆								◆				◆	
Cargo Rail Storage				◆								◆				◆	
General Purpose Storage				◆								◆				◆	
WRM/Aircraft Specific Storage				◆								◆				◆	
Comfort Pallet Storage				◆								◆				◆	
ADS/Escape Slide Storage				◆								◆				◆	
Open Storage				◆								◆				◆	

Table 6-C: Finish Schedule for Alternate Mission Equipment (AME -21) Functional Areas.

References

ACGIH	American Conference of Governmental Industrial Hygienist, Industrial Ventilation, A Manual of Recommended Practice
AFH 32-1084	Standard Facility Requirements Handbook
AFI 32-1021	Planning and Programming Facility Construction Projects
AFI 32-1023	Design and Construction Standards and Execution of Facility Construction
AFI 32-1024	Standard Facility Requirements
AFI 32-1032	Planning and Programming Real Property Maintenance Projects Using Appropriated Funds
AFI 32-7042	Solid and Hazardous Waste Compliance
AFI 88-3	Structural Design Criteria Loads
AFM 91-201	Explosives Safety Standards
AFJM 32-1013	Airfield and Heliport Planning and Design
AFP 88-40	Sign Standards
ADA	Americans with Disabilities Act
DoD 4270.1-M	Construction Criteria Manual
DoD 6055.9	Ammunition and Explosives Safety Standards
FED STD. 795	Uniform Federal Accessibility Standards (UFAS)
IES	Illuminating Engineering Society, Lighting Handbooks
MIL-HDBK 1008B	Fire Protection for Facilities Engineering, Design, and Construction
MIL-HDBK 1190	Military Building Code
NFPA10	Portable Fire Extinguishers
NFPA 70	National Electric Code
NFPA 101	Life Safety Code
NFPA 220	Types of Construction
UBC	Uniform Building Code
10 CFR Chapter 11	Energy Conservation Voluntary Performance Standards for New Buildings
AMC	Commander's Guide to Facility Excellence
AMC	Architectural Compatibility Plans
AMC	Interior Design Guide
AMC	Landscape Design Guide
AMC	Sign Standards, "Engineering Technical Letter" (ETL 93-02)
	Air Force Center for Environmental Excellence, Air Force Environmentally Responsible Facilities Guide
ASHRAE	American Society of Heating Refrigerating and Air-Conditioning Engineers, Handbooks
SMACNA	Sheet Metal & Air Conditioning Contractors National Association, Standards
T.O. 33B-1-1	Technical Manual Nondestructive Inspection Methods