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12 August 2020

UNIFIED FACILITIES CRITERIA (UFC)

DOD FUELS LABORATORY STANDARDS

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UNIFIED FACILITIES CRITERIA (UFC)

DOD FUELS LABORATORY STANDARDS

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U.S. ARMY CORPS OF ENGINEERS MANDATORY CENTER OF EXPERTISE FOR PETROLEUM, OIL, AND LUBRICANTS (POL) MCX (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER CENTER

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

Change No.	Date	Location

FOREWORD

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

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

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

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

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

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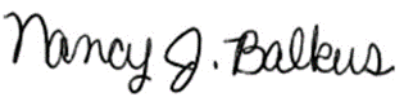

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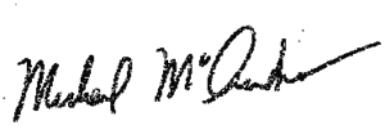

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UNIFIED FACILITIES CRITERIA (UFC)
NEW SUMMARY SHEET

Document: UFC 4-310-03, *DoD Fuels Laboratory Standards*, dated 7 March 2019

Superseding: None

Description: This new UFC provides general criteria and standard procedures for the design and construction of military land-based laboratory facilities which test liquid fuels.

Reasons for Document:

- Provide uniform requirements for construction of DoD fuels laboratories based on required fuel testing requirements.
- Provide requirements for planning, facility design, and construction documentation required for new fuel laboratory facilities.
- Provide requirements for modernization or expansion of existing fuel laboratories, if improvements can be justified in terms of obsolescence, expanded operational requirements, safety, environmental compliance, or excessive maintenance costs.

Impact:

- Creates a single source for common DOD fuels laboratories criteria.
- Enable designs and construction to meet appropriate uniform requirements for specific fuel testing locations to ensure proper fuel quality for use within DoD.

Unification Issues

None

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This UFC contains criteria and guidance for design and construction of military land-based laboratory (lab) facilities that test liquid fuels.

1-2 APPLICABILITY.

This UFC should be used by facility planners, engineers, and architects for individual project planning and preparing engineering and construction documentation. Requirements apply to both new construction and to modernization or expansion of existing fuel laboratories when improvements can be justified in terms of obsolescence, expanded operational requirements, safety, environmental compliance, or excessive maintenance costs. Operations and maintenance personnel should use this UFC for facility design, modifications, and improvements.

1-3 GENERAL BUILDING REQUIREMENTS.

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

1-4 CYBERSECURITY.

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service implementation policy.

1-5 SERVICE HEADQUARTERS SUBJECT MATTER EXPERTS (SME)

Policies, obligations, and responsibilities of the military branches may vary; consult the SME at the appropriate Service headquarters for interpretation.

- Army: Headquarters, U.S. Army Corps of Engineers, POL Facilities Proponent (CECW-EC).
- Air Force: The Air Force Fuels Facilities SME (AFCEC/COS). When applicable, route requests through the Regional Fuels Engineer (USAFE/PACAF) prior to the Air Force Fuels Facilities SME.
- Navy/Marine Corps: NAVFAC POL Facility SME (NAVFAC EXWC, CI11).

1-5.1 Service Provider Subject Matter Expert (SME).

DLA Installation Support for Energy (DLA DS-FEI) is the Executive Agent as defined in DoD 4140.25M.

1-6 WAIVERS AND EXEMPTIONS.

For specific interpretations, waivers, or exemption, contact the appropriate Service headquarters SMEs and refer to MIL-STD-3007 for the waiver process.

Recommended UFC language generated from recurring waivers and exemptions will be considered by the Fuels Discipline Working Group (FDWG), with supporting rationale for inclusion included on voting agendas.

1-7 REFERENCES.

Appendix A lists references related to laboratory facilities contained in this UFC. The publication date of the code or standard is not included; the latest available issuance of the reference has been used.

1-8 PROJECTS OUTSIDE OF CONTINENTAL UNITED STATES.

For fueling projects located outside of CONUS, use host nation standards (if more stringent), this UFC, and applicable Service policy.

1-9 GLOSSARY.

Appendix B contains abbreviations and acronyms, and definitions of terms.

CHAPTER 2 TECHNICAL REQUIREMENTS

2-1 BASIC LAB REQUIREMENTS.

Laboratories are classified as Type A, B, or C to match testing required in MIL-STD-3004. These requirements apply to all labs. Requirements for counter space, ventilation, and electrical are summarized in Table 2-1. Specific requirements for each lab are determined by the tests performed in the lab.

2-1.1 Petroleum Products.

Petroleum products are hazardous due to toxic, explosive, flammable, and environmentally damaging properties.

2-1.2 Codes, Standards and Regulations.

Design must conform to all applicable criteria and guidance, including local and federal codes, military standards, and installation standards. Approved DD Form 1391 must specify what lab type is required to meet assigned tasks to support MIL-STD-3004.

Use references listed in Appendix A. Other standards may be acceptable provided they satisfy minimum requirements for the testing lab.

2-1.3 Architectural.

2-1.3.1 Floors.

To retain shower water and fuel spills, recess for laboratory room floors a minimum of 6 in. (150 mm), or provide another means of permanent spill control. If only eyewash units are used, the floor does not need to be recessed, but must be sloped 1/8-inch per foot to a floor drain. Floors must be designed to support minimum loads of 150 pounds per square foot (7.18 kilopascals). The finish should be monolithic, without seams or joints, to resist fuel spills. Flooring must incorporate a cove-type base of the same material as the flooring.

2-1.3.2 Cabinets.

Cabinets must be of metal construction and sourced from a manufacturer that specifically designs and builds laboratory fixtures. Coordinate with the user as to the type of cabinets that will be required.

2-1.3.3 Countertops.

Where fuel or chemicals may contact countertops, a standard 4-inch (100 millimeter) chemical- and fuels-resistant backsplash must be installed. Counters must be made of an epoxy resin or other type of material typically used for chemical analysis. For instrumentation, countertops must support 150 pounds per square foot (7.18 kilopascals) minimum load. Countertops typically are black, but verify with the user the

color needed to accommodate types of testing. At some installations, a white epoxy resin countertop may be required for the visual test.

2-1.4 Mechanical.

2-1.4.1 Heating, Ventilating and Air Conditioning (HVAC) System.

Labs work spaces must have dedicated HVAC systems and must provide a minimum outdoor air ventilation rate in accordance with ASHRAE 62.1 and comply with UFC 3-410-01.

- Lab HVAC systems must work seamlessly. When a lab hood is energized, conditioned make-up air must enter the lab to replace the air being exhausted. The design must ensure minimum turbulence around the hood, and ensure all components work together in a variety of scenarios; e.g., lab hoods are normally shut down when not in use; fresh air would normally go to minimum volume when the building is unoccupied.
- Lab rooms must maintain slightly negative air pressure relative to the rest of the building (adjacent rooms) 24 hours per day, 7 days per week.

2-1.4.1.1 Lab Operating Temperature.

Operating temperature must be maintained at 73° F +/- 5° F (23 +/- 2 ° C), 55° F (13° C) maximum dew point, and humidified if relative humidity drops below 30%.

2-1.4.1.2 Recirculation of Air from the Laboratory.

Recirculation of air from the laboratory to other portions (offices) of the building is prohibited, per NFPA 45.

2-1.4.1.3 Exhaust.

Labs must provide exhaust 24 hours per day, 7 days per week, from within 6 inches of the lab floor; i.e., the exhaust intake must be mounted no more than 6 inches above the lab floor. For C type labs, maintain a minimum airflow of 50 cubic feet per minute (25 liters/second).

2-1.4.1.4 Energy Recovery Systems.

Use of energy recovery systems must be considered. To prevent possible cross-contamination, do not use recovery wheels with fume hoods.

2-1.4.1.5 High Performance and Sustainable Building Requirements.

Comply with UFC 1-200-02.

2-1.4.2 Plumbing.

Comply with UFC 3-420-01.

2-1.4.3 Sinks.

Sinks must supply both hot and cold running water. For cleaning lab glassware, hot water must be supplied at 130° F (54° C).

2-1.5 Electrical.

This UFC applies to facilities within the United States. Installations outside the United States may have location-specific power requirements.

2-1.5.1 Primary Power Distribution.

A dedicated service transformer is required for facility primary power distribution. The transformer must step down voltage from the installation primary voltage to 120/208V three-phase power. HVAC and other mechanical loads typically require three-phase power. When part of a larger building, laboratories must have dedicated distribution panels.

2-1.5.2 Stand-By-Generator.

This UFC does not require use of a stand-by generator, nor does any specific service or installation have a requirement that the fuels laboratory have emergency power. However, the laboratory must be considered inoperable and possibly uninhabitable during a prolonged power outage. At a minimum, the facility must have backup power capability via a quick connection point through a manual transfer switch (MTS). A built-in stand-by generator with automatic transfer switch (ATS) may be justified based on the power reliability of a specific installation and the criticality of the laboratory mission.

2-1.5.3 Service Entrance Conductors.

Service entrance conductors must be extended from the service transformer or MTS to a main distribution panel (MDP) in the mechanical room. The MDP must be service entrance-rated and equipped with molded case circuit breakers. Feeders must be extended from the MDP to feed the large mechanical loads and 208Y/120V panel boards. The 208Y/120V panel boards must feed lighting, small mechanical loads, receptacle loads, and other 120V or 208V equipment. Identify laboratory equipment utilizing 208V for disconnect placement.

2-1.5.4 Lab Equipment Transformer.

Some lab equipment may be available only as 240V, requiring a second transformer with a 120/240V single-phase secondary. Identify laboratory equipment requiring 240V for disconnect placement.

2-1.5.5 Lighting.

Design lighting to intensities recommended in UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*. In general, laboratory lighting will be non-hazardous,

but specific areas/locations may require special lighting; e.g., the hazardous storage area must have explosion-proof fixtures.

- Provide occupancy sensor controls and manual override switches throughout the facility. LED lighting is acceptable in place of fluorescent.
- Exit signs and emergency light fixtures must have battery backup; exit lights will use LED lamps.

2-1.5.6 Electrical Outlets and Switches.

Electrical outlets and switches must be located above counter- or tabletop-height. Space regular duplex outlets (120V) every 4 feet along countertops to support various equipment items. Dedicated 208V and 240V outlets must positioned to accommodate equipment that requires power other than 120V. Consult the end user regarding these specific power requirements. As a minimum for each laboratory, provide two 240V outlets near the ends of counters to allow use by either countertop or floor-standing equipment.

2-1.5.7 Lighting Building Exterior Walls.

Illuminate building exterior walls using full cut-off wall pack LED fixtures controlled via photocell mounted on the exterior of the building -- not on the roof.

2-1.5.8 Facility Grounding.

The facility must be grounded in accordance with NFPA 70, *National Electrical Code*®. Execute underground connections by exothermic process. Existing systems must be tested and supplemented as needed to obtain a ground resistance of 25 ohms or less.

2-1.5.9 Personnel and Equipment Grounding Bar.

Provide a personnel and equipment grounding bar for all laboratory countertops. Provide a personnel grounding touch pad or bar at laboratory entrances.

2-1.5.10 Lightning Protection.

Provide lightning protection per UFC 3-575-01 and NFPA 780.

2-1.5.11 Exterior Raceways.

Use rigid steel conduit or intermediate metal conduit (IMC) in exposed locations. Install electric metallic tubing (EMT) where concealed in walls and above finished ceilings. Exposed exterior conduits or exposed conduits in hazardous classified areas must be rigid galvanized steel. Use PVC underground. Transition PVC conduit to PVC-coated rigid steel conduit for below grade elbows and where conduits rise through concrete slabs.

2-1.5.12 Electrical Classification.

Electrical installations in the laboratory work areas are considered non-classified with exceptions identified in paragraphs 2-2.4, 2-.3.2, and 2-3.4.

[C] 2-.1.5.12 The laboratory work areas are non-classified due to following mitigating factors:

- Procedural limits on fuel quantity to be tested or stored within the laboratory.
- Storage of fuel samples in ventilated cabinets or otherwise approved containers.
- Training of operators and the area being off limits to non-essential personnel.
- Reasonable expectation that any fuel spills will be cleaned up immediately.
- Physical separation of the hazardous storage area (a hazardous area) from the laboratory.
- Required fire sprinklers.
- Combustible gas monitors in larger labs with piped in Hydrogen, Oxygen, Acetylene or other gases which would increase the fire potential.
- Use of fume hood(s) and dedicated HVAC system to remove any fuel vapors.
- Elevating all electrical outlets to at or above counter-top height. The test equipment itself is not hazardous area rated, therefore requiring the rest of the electrical system to be hazardous area rated would not increase safety.
- Open flame tests are required in the laboratory, but would be prohibited in a hazardous area.

2-1.6 Fire Protection Requirements.

Comply with UFC 3-600-01 and NFPA 45.

Determine what chemicals and fuels will be tested and stored in the lab. Document and include client requirements in the design analysis. Table 2-2 lists some typical chemicals and fuels. Chemical/sample storage rooms must be classified as Class 1, Division 2, and Group D, in accordance with NFPA 70. Lab facilities must be Type I or Type II construction (IBC Classification).

2-1.7 Emergency Eyewash and Shower.

Provide an OSHA emergency eyewash and shower supplied per Appendix D of UFC 3-420-01. Designers must review availability of existing utilities and evaluate conditions at each site.

2-2 TYPE A TESTING LAB.

Requirements for counter space, ventilation, electrical, and other features are listed in Table 2-1.

2-2.1 Facility Description.

A facility capable of performing a Type A Test is described in MIL-STD 3004. These facilities are the largest of the DoD laboratories, very expensive, and few in number relative to Type B and C labs. Because requirements for labs are project-specific, a single uniform standard is not practical, making requirements for smaller labs, as a minimum, apply to all types. Examples of Type A labs include Wright Patterson AFB, Vandenberg AFB, RAF Mildenhall, Kadena Air Base, NAS Patuxent River, and New Cumberland Army Depot.

a. The Type A test consists of a complete conformance specification acceptance test. Sample size must include 1 gallon (3.8 liters), with 5 gallons (18.9 liters) for special tests, as specified in MIL-STD 3004.

b. Table 2-1 is a list of tests; Figure 2-1 provides a diagram of a Type A laboratory.

2-2.2 Architectural.

2-2.2.1 Design.

Building size must be based on space requirements, as indicated in Table 2-1 or as approved by the Service Control Point identified in UFC 3-460-01, to provide the user with a complete operational facility. Finishes of building exteriors must follow installation standards for materials.

2-2.2.2 Handicapped Accessibility.

Handicapped accessibility requirements will be incorporated into the building design in accordance with the ADA-ABA American with Disabilities Act and Architectural Barriers Act Accessibility Guidelines for Buildings and Facilities.

2-2.2.3 Building Requirements.

Use Table 2-1 to determine space layout. Multiple test stations may be added as required to accomplish the number of tests for each station. The functional areas for a large laboratory facility must include the spaces described in paragraphs 2-2.2.3.1 through 2-2.2.3.9, as a minimum:

2-2.2.3.1 Laboratory Rooms.

Approximate size of lab rooms should be between 2,000 and 3,200 net square feet (185 and 298 net square meters). Size maybe adjusted as required for a larger lab with rooms or areas being added for additional requirements.

a. A Type A lab must be sized to handle all required testing for the basic lab requirements, including fuels and lubricating oils. Fuels and lubricants typically tested inside the lab include:
    - aviation gasoline (AVGAS)
    - biofuels
    - biomass fuel
    - biodiesel
    - diesel fuel
    - ethanol, fuel grade
    - gasoline
    - heavy distillates
    - aviation turbine fuel (e.g., JP-5, JP-8, Jet A, F-24)
    - kerosene
    - LNG, LPG
    - natural gas
    - petroleum and crude oil feedstocks
    - petroleum coke and fly-ash
    - lube oil

b. For typical fuel tests conducted inside the lab, see Table 2-1.

c. A Type A lab must be set up to allow individual testing of the items listed above and can be separated into two testing rooms. One room must be large -- approximately 1,800 net square feet (167 net square meters) -- with a flash room and balance room located adjacent to the lab. The other must be a minimum of 500 net square feet (47 net square meters), adjacent to the larger room. Each room/lab area must be set up to test the listed items and must be laid out to allow separate areas for each test (reference Table 2-1). Several testing stations could be combined into one. When required, include additional space in each Type A lab for a filtration room or equipment storage.

2-2.2.3.2 Non Hazardous Storage Room.

This room (or rooms) is used to store non-hazardous chemicals, and will include noncombustible storage compartments and work tables.

a. Size: The approximate size of this area should be 400 net square feet (37 net square meters).

b. Flooring: Flooring must be monolithic in type, without seams or joints, and must resist chemical and fuel spills. A cove base of the same material must extend up approximately 8 in. (200 mm).

c. Walls: Walls must be constructed using steel studs with a maximum 16 in. (400 mm) on center, covered with 5/8-in. (16-mm) gypsum wallboard or concrete masonry, and a backsplash or wainscot at all casework. Backsplash or wainscot must be chemical- and fuels-resistant.

d. Counters: Counters must be epoxy resin-type typically used for chemical analysis, resistant to chemical and fuel spills, and easily cleaned. Most counters are black; but the color must be selected by the using agency as appropriate to support its testing operations.

e. Ceilings: Ceilings must consist of 5/8-in. (16 mm) gypsum wallboard over steel studs, mounted at 16 in. (400 mm) on center. The minimum ceiling mounting height must be 8 ft (2400 mm) above the finish floor. Ceilings must be painted with one coat of primer and two coats of semi-gloss paint. Color must be selected from manufacturer standard paint samples.

2-2.2.3.3 Hazardous Storage Room.

The hazardous storage room provides space for the storage of chemicals and flammable and hazardous materials. Refer to Table 2-2 for a list of potential chemicals that may be stored in this room. This room must have direct access to the exterior. In addition, a storage area for pressurized bottles must be located on the exterior of the building adjacent to the hazardous storage room, and also have exterior access.

a. Flooring: Reference paragraph 2-2.2.3.2.b.

b. Walls: Reference paragraph 2 2.2.3.2.c.

2-2.2.3.4 Filtration Room.

The filtration room must be approximately 250 net square feet (23 net square meters), and adjacent to the laboratory areas to provide filtered air into the laboratory. This room (or area) may be inside the laboratory or within a support area.

2-2.2.3.5 Balance Room and Flash Room.

Each of these rooms must be approximately 150 net square feet (13 net square meters) each. Locate both rooms next to and with access into the laboratory areas. Provide backsplash or wainscot that is chemical- and fuel-resistant.

a. Counters: Reference paragraph 2-2.2.3.2.d.

b. Ceilings: Reference paragraph 2-2.2.3.2.e.

2-2.2.3.6 Administrative Office Spaces.

Provide a minimum of one open office approximate size of 375 net square feet (35 net square meters) and one single office approximately 150 net square feet (12 net square meters). Administration offices must be separated from the lab area but must be adjacent to it for ease of access. Size the administration office area to accommodate the number of assigned staff.

a. Walls: Walls must be constructed using steel studs with a maximum 16 in. (400 mm) on center, and covered with 5/8-in. (16-mm) gypsum wallboard.

b. Flooring: Flooring may be resilient or porcelain tile.

c. Ceilings: Use acoustical tile for ceilings.

2-2.2.3.7 Break Room Spaces.

Provide a break area of approximately 300 net square feet (28 net square meters) adjacent to office areas and away from the hazardous storage and laboratory areas. The break room must include space for a counter, table, and refrigerator.

a. Walls: Reference paragraph 2-2.2.3.6.a.

b. Flooring: Reference paragraph 2-2.2.3.6.b.

c. Ceilings: Reference paragraph 2-2.2.3.6.c.

2-2.2.3.8 Support Space.

Mechanical, electrical, and communication rooms must be sized to accommodate equipment required for the building. Rooms must be accessible from the exterior of the building, or comply with current security requirements. Walls must constructed using steel studs at a minimum of 16 in. (400 mm) on center, covered with 5/8-in. (16-mm) gypsum wallboard or painted concrete masonry. Flooring may be resilient or porcelain tile, or sealed concrete. Ceilings for these spaces may be exposed to the underside of any metal decking or roof.

2-2.2.3.9 Toilet and Locker Rooms.

Men’s and women’s toilet and locker rooms must be sized according to the number of people that will be using the spaces. Locate these rooms between the break room and laboratory to achieve separation and promote proper industrial hygiene.

a. Walls: Walls must be constructed using steel studs with a minimum 16 in. (400 mm) on center, covered with 5/8-inch (16-mm) gypsum wallboard.

b. Tile: Wallboard must be covered with a porcelain tile wainscot with backboard in the toilet room and locker area, and full-height porcelain tile with backboard in the shower room.

c. Flooring: Shower flooring should include shower pans or porcelain tile. Flooring for the toilet and locker areas can be ceramic or porcelain tile.

d. Ceilings: Ceilings must be 5/8-in. (16 mm) gypsum wallboard.

2-2.3 Mechanical.

Comply with requirements in paragraph 2-3.3 for a Type B lab.

2-2.4 Electrical.

In addition to the basic lab requirements of paragraph 2-1.4, Type A labs must be equipped with combustible gas monitors with alarms as indication of either an HVAC failure or piped natural gas (or other gas) leak creating a potentially dangerous buildup of explosive gases.

Type A labs must also have hazardous areas that require electrical explosion-proofing. These areas are classified Hazardous, Class 1 Division 1:

- Hazardous storage room
- Areas within 5 feet (1524 mm) of hazardous storage cabinets (or refrigerator)
- Interior of lab fume hoods
- 5 feet (1524 mm) around any fuel waste containers larger than 5 gallons (18.9 liters).

2-3 TYPE B TESTIG LAB.

Requirements for counter space, ventilation, electrical, and other items are listed in Table 2 1.

2-3.1 Facility Description.

A Type B testing lab is a facility capable of performing Type B tests, as described in MIL-STD 3004. A Type B-1 test consists of a partial analysis comprising the checking of principal characteristics most likely to have been affected in the course of moving the product. A Type B-2 test consists of a partial analysis to check characteristics susceptible to deterioration due to age. Examples of Type B labs include Hunter Army Airfield, Ft Rucker, Ft Campbell, Chibana, FLC Norfolk, FLC Jacksonville, Naval Station Rota, and FLC Point Loma. See Figure 2-2.

A Type B-3 test consists of partial analysis for contaminations -- in particular, for controlling the return (or reintroduction) of pipeline interface products. Sample sizes must include 1 gallon (3.8 liters), and 5 gallons (18.9 liters) for special tests, as indicated in MIL-STD 3004. For a minimum list of tests, see Table 2-1.

2-3.2 Architectural.

2-3.2.1 Architectural Design.

Size of building must be based on tests as indicated in Table 2-1 to provide the user with a complete operational facility. Size of this type of facility may be increased as mission at each installation dictates. Minor modifications to the configuration may be

developed during review conferences. Finishes of the exterior of buildings for this project must follow base standards for exterior materials.

2-3.2.1.1 Handicapped Accessibility.

Handicapped accessibility requirements will be incorporated into the building design. The design must follow the ADA-ABA American with Disabilities Act and Architectural Barriers Act Accessibility Guidelines for Buildings and Facilities.

2-3.2.2 Building Requirements.

Functional areas for a medium-sized laboratory facility must include spaces as described in paragraphs 2-3.2.2.1 through 2-3.4.

2-3.2.2.1 Laboratory Room.

The laboratory room contains testing supplies, laboratory casework, laboratory counters tops, and small storage cabinets. Finish materials -- flooring, walls, casework, and countertops -- must resist flammable and combustible liquids. The approximate size of the laboratory room must be between 1,200 and 2,000 net square feet (112 and 186 net square meters).

Laboratory casework must be designed and installed to provide an efficient working environment. Required built-in equipment includes laboratory hoods, work tables, and laboratory casework.

a. Counters: Counter heights must be adjusted to allow for a proper working height with required equipment from a standing position. Laboratory counters must be a black epoxy resin material typically used for a laboratory rooms, and resistant to chemical and fuel spills and easily cleaned.

b. Cabinets: Cabinets must be constructed using metal that will resist rusting and must conform to industry standards for scientific laboratory equipment. Cabinets must be flush-front in construction, with interiors built for storage of equipment and flammable or combustible liquids. Upper storage cabinets must have glass fronts.

c. Flooring: Flooring must be a monolithic type without seams or joints, and resistant to chemical and fuel spills.

d. Walls: Reference paragraph 2-2.2.3.2.c.

Fuels and lubricants tested inside the lab typically include:

- aviation gasoline (AVGAS)
- biofuels
- biodiesel
- diesel fuel
- ethanol, fuel grade

- fuel oil, gas oil, bunker fuel
- gasoline
- aviation turbine fuel (JP-5, JP-8, Jet A, F-24, etc.)
- kerosene
- lube oil

For fuel testing typically done inside the lab, see Table 2-1.

2-3.2.2.2 Chemical Analysis Room.

The approximate size of the chemical analysis room is 260 net square feet (24 net square meters). Adjust the size as needed to accommodate the number of personnel assigned to this area. Casework must be designed and installed to provide an efficient working environment.

a. Counters: Counters must be made of black epoxy resin, typically used for chemical analysis, and must resist chemical and fuel spills and be easily cleaned. Adjust counters to heights correct for working with required equipment from a standing position.

b. Cabinets: Reference paragraph 2-3.2.3.1.b.

c. Flooring: Reference paragraph 2-2.2.3.2.b.

d. Walls: Reference paragraph 2-2.2.3.2.c.

2-3.2.2.3 Non Hazardous Storage Room.

This space houses non-hazardous chemicals, and will include noncombustible storage compartments and work tables. The approximate size is 200 net square feet (37 net square meters).

a. Flooring: Reference paragraph 2-2.2.3.2.b.

b. Walls: Walls must be constructed using steel studs with a maximum 16 in. (400 mm) on center, covered with 5/8-in. (16-mm) gypsum wallboard or concrete masonry, and a backsplash or wainscot at all casework.

2-3.2.2.4 Hazardous Storage Room.

The hazardous storage room is used to store hazardous and nonhazardous chemicals, along with noncombustible storage compartments and work tables. The approximate size of the hazardous storage room is 100 net square feet each (10 net square meters each).

a. Counters: Counters must be black epoxy resin material typically used for chemical analysis, resistant to chemical and fuel spills, and must be easily cleaned.

b. Flooring: Reference paragraph 2-2.3.2.2.b.

c. Walls: Reference paragraph 2-2.2.3.2.c.

d. Ceilings: Reference paragraph 2-2.2.3.2.e.

2-3.2.2.5 Filtration Room.

The filtration room must be approximately 250 net square feet (23 net square meters), and adjacent to the laboratory areas to provide filtered air into the laboratory. This room (or area) may be inside the laboratory or within a support area.

2-3.2.2.6 Balance Room and Flash Room.

Each of these rooms must be approximately 150 net square feet (13 net square meters) each. Locate both rooms next to and with access into the laboratory areas. The balance area may be located within the laboratory if only one table is required. Casework must be designed and installed to provide an efficient working environment.

a. Counters: Counters must be an epoxy resin type typically used for chemical analysis. Counters must be resistant to chemical and fuel spills and must be easily cleaned. Color of counters must be selected from standard color of epoxy resin types. Counter heights must be adjusted to allow for a proper working height with required equipment from a standing position.

b. Cabinets: Reference paragraph 2-3.2.2.1.b.

c. Flooring: Reference paragraph 2-2.2.3.2.b.

d. Walls: Walls must be constructed using steel studs at 16 inches (400 mm) on center covered with 5/8-in. (16-mm) gypsum wallboard, with a backsplash or wainscot at casework that is chemical and fuels resistant.

e. Ceilings: Reference paragraph 2-2.2.3.2.e.

2-3.2.3 Administrative Office Spaces.

Size the administration office area to accommodate the number of assigned staff. Provide a minimum of one open office approximate size of 375 net square feet (35 net square meters) and one single office approximately 150 net square feet (12 net square meters). Administration offices must be separated from the lab area but must be adjacent to it for ease of access.

a. Walls must be constructed using steel studs with a maximum 16 in. (400 mm) on center, and covered with 5/8-in. (16-mm) gypsum wallboard.

b. Flooring may be resilient or porcelain tile. Use acoustical tile for ceilings.

2-3.2.3.1 Support Spaces.

Mechanical, electrical, and communication rooms must be sized to accommodate equipment required for the building. Rooms must be accessible from the exterior of the building, or comply with current security requirements. Walls must constructed using steel studs at a minimum of 16 in. (400 mm) on center, covered with 5/8-in. (16-mm) gypsum wallboard or painted concrete masonry. Flooring may be resilient or porcelain

tile, or sealed concrete. Ceilings for these spaces may be exposed to the underside of any metal decking or roof.

2-3.2.3.2 Toilet and Locker Rooms.

Men's and women's toilet and locker rooms must be sized according to the number of people that will be using the spaces. Locate these rooms between the break room and laboratory to achieve separation and promote proper industrial hygiene. Walls must be constructed using steel studs with a minimum 16 in. (400 mm) on center, covered with 5/8-inch (16-mm) gypsum wallboard. Wallboard must be covered with a porcelain tile wainscot with backboard in the toilet room and locker area, and full-height porcelain tile with backboard in the shower room. Shower flooring should include shower pans or porcelain tile. Flooring for the toilet and locker areas can be ceramic or porcelain tile. Ceilings must be 5/8-in. (16 mm) gypsum wallboard.

2-3.3 Mechanical.

Items described in paragraphs 2-3.3.1 and 2-3.3.2 are required in addition to Type C++ requirements (paragraph 2-4.3).

2-3.3.1 Lab Operating Temperature.

Lab operating temperature must be maintained 24 hours a day, 7 days a week, or as directed by project requirements.

2-3.3.2 Hazardous Storage Room.

The hazardous storage room is classified as a Class 1 Division 1 Hazardous Space which requires all equipment associated with the room to be explosion-proof. The room must be exhausted 24 hours per day, 7 days a week, to remove vapors and ensure a slightly negative air pressure relative to the rest of the building (adjacent rooms).

2-3.4 Electrical.

In addition to the basic lab requirements of paragraph 2-1.4, Type B labs must be equipped with combustible gas monitors with alarms as indication of either an HVAC failure or piped natural gas (or other gas) leak allowing a dangerous buildup of potentially explosive gases.

Type B labs will also have hazardous areas that require electrical explosion-proofing. These areas are considered Hazardous (Classified) Locations, Class 1 Division 1:

- Chemical storage room
- Areas within and 5 feet (1524 mm) around hazardous storage cabinets (or refrigerator).
- Interior of fume hoods

- 5 feet (1524 mm) around any fuel waste containers larger than 5 gallons (18.9 liters).

2-4 TYPE C TESTING LAB.

Requirements for each lab are determined by the tests performed in the lab. Requirements for counter space, ventilation, electrical, and other items are listed in Table 2-1.

2-4.1 Facility Description.

A Type C lab is a facility capable of performing a Type C test, as described in MIL STD 3004. A Type C test consists of a quick, simple, partial analysis for verification of product quality, and to ensure no change has taken place. Type C tests are sometimes referred to as identifications tests. A number of labs are referred to as C++ labs. The Air Force has C++ labs at many installations capable of all of the C-level tests, plus several additional tests. In the Air Force C++ labs, a lab fume hood and additional counter space is required. For a list of tests, see Table 2-1.

Fuels and lubricants tested inside the lab typically include:

- AVGAS
- aviation turbine fuel (JP-5, JP-8, Jet A, F-24)
- gasoline
- E85
- diesel
- kerosene
- B20
- burner fuel oils
- lube oil

Examples of C Type labs include Ft Polk, Ft Irwin, Quantico, Ft Drum. Typical Type C++ labs are found on Air Force Bases, including Eglin, Grand Forks, Ellsworth, and Holloman. See Figures 2-3 and 2-4.

2-4.2 Architectural.

2-4.2.1 Handicapped Accessibility.

These labs will accommodate able-bodied individuals only. If the Type C or C++ lab is part of a larger building, and the building must be designed in accordance with ABA/ADA, the Type C or C++ lab does not need to be designed in accordance with ABA/ADA.

2-4.3 Mechanical.

Paragraphs 2-4.3.1 through 2-4.5 are required in addition to basic lab requirements (paragraph 2-1.3).

2-4.3.1 Lab Operating Temperature.

Lab operating temperature must be maintained during normal business hours; night setback is acceptable unless otherwise directed by project requirements.

2-4.3.2 Fume Hood.

2-4.3.2.1 Science Fume Hood.

A science fume hood must be of benchtop design, categorized as an Educational Fume Hood, with a minimum opening of 18 in. x 8 in. (457 mm x 200 mm), and minimum working space of 24 in. wide (W) x 13 in. deep (D) x 22 in. high (H) (610 mm W x 330 mm D x560 mm H); ducted; exhausting approximately 100 cfm (50 liters/sec).

The hood may be designed to operate while the sash (hood access door) is in the partially-opened position only. In addition:

- An on/off switch for the exhaust fan must be provided near the fume hood.
- Exhaust ductwork must be sealed.
- Exhaust streams must be exhausted directly to the building exterior.
- Face velocity must be designed to 100 fpm (0.5 m/s).
- Exhaust fan must be located on the roof, in accordance with NFPA 45.
- Exhaust fan must be of spark-resistant construction.
- Exhaust fan motor must be explosion-proof if located in the air stream.
- Exhaust stack discharge velocity must be at least 3,000 fpm (15 m/s).
- Exhaust must be a minimum of 30 ft (9 m) from any building fresh air intake.
- Exhaust must be labeled “WARNING – Chemical Laboratory Exhaust”
- Exhaust stack must discharge vertically and be located a minimum of 10 ft (3 m) above adjacent roof lines.

2-4.4 Lab Fume Hood.

For a typical Air Force C++ lab, a 47- or 60-in. (1200- or 1525-mm) lab fume hood is required (size is dictated by the number of samples/tests to be performed on a daily basis), and must be ducted, approximately 750 cfm (354 liters/sec) or 1000 cfm (472 liters/sec), respectively. The hood must be designed to operate while the sash (hood access door) is in any position (fully opened to fully closed). Good ventilation is

achieved by using a lab fume hood in a small room, even when the test is not performed in the hood. In addition:

- An on/off switch for the exhaust fan must be provided near the fume hood.
- Exhaust duct work must be chemical-resistant.
- Exhaust duct work must be sealed.
- Exhaust duct work must not be manifolded together with other lab hoods on a constant volume system.
- Exhaust streams containing concentrations of flammable vapors above the lower explosion limit (LEL) must not be connected to a centralized exhaust system, per ANSI/ASSE Z9.5, *Laboratory Ventilation*.
- Hood must be equipped with a flow indicator, flow alarm, or face velocity alarm indicator set to alarm when the face velocity falls outside the range of 80 to 100 fpm (0.4 to 0.5 m/s).
- Face velocity must be designed to 100 fpm (0.5 m/s).
- Exhaust fan must be located on the roof in accordance with NFPA 45.
- Exhaust fan must be of spark-resistant construction.
- Exhaust fan motor must be explosion-proof if located in the air stream.
- Exhaust stack discharge velocity must be at least 3,000 fpm (15 m/s).
- Exhaust must be a minimum of 30 feet (9 m) from any building fresh air intake.
- Exhaust must be labeled “WARNING – Chemical Laboratory Exhaust”.
- Exhaust stack must discharge vertically and be located a minimum of 10 ft (3 m) above adjacent roof lines.
- Controls (air, water, gas,) must be located exterior to the hood within easy reach.

During commissioning, the following tests and measurements must be performed in accordance with ANSI/ASSE Z9.5:

- Airflow visualization tests
- Cross drafts velocity tests
- Exhaust flow measurements
- Face velocity tests
- Hood static pressure measurement
- Tracer gas testing

2-4.4.2 Make-up Air for Fume Hood.

Make-up air for the fume hood must meet the lab operating temperature requirements.

2-4.4.3 Vacuum Pump.

A vacuum pump must be provided serving the lab fume hood if required by the appropriate fuel test. The vacuum pump must be installed higher than the hood for the vacuum line to drain back into the fume hood. An on/off switch must be located near the fume hood. The vacuum pump requires good ventilation, so installation in the same room as the lab hood is adequate. **Note:** A vacuum pump is not required for a Type C testing lab.

2-4.4.4 Floor Drains.

Floor drains must be provided for emergency showers. Drains must be equipped with a positive sealing plug which is inserted in the drain at all times when not in use, or some other means of stopping the drain system. Drains are opened only as needed or after liquid is approved for discharge into the drain system.

2-4.4.5 Deionizer Water Tap.

A water supply tap for a Type II deionizer water equipment (typically wall-mounted) must be provided for Type C++. Provide a deionizer tap for Type C only when requested.

2-4.4.6 Glassware Cleaning.

The lab must be designed for glassware cleaning (dishwasher), but is not required for Type C and C++ labs unless the number of daily samples is high enough based on installation throughput and manpower requirements.

a. Prior to cleaning glassware, all fuel from testing is dumped into containers which are either recycled or properly disposed of. Lab personnel are trained not to dump fuels (hazardous waste) into any sink or floor drain. Glassware is essentially empty, except for any residual fuel clinging to the container. Detergents used to clean and break down the residual fuel from the glassware are subsequently dumped into the drain system.

b. There is no state or federal regulation which requires special treatment of discharge from a DoD fuels lab operating under these conditions. A local or host nation requirement may specifically address and require oil/water separators, intermediary containment basins, or some other means to address residual fuel. A large lab with high quantities of samples might justify environmental concerns to assure safe discharge.

2-4.5 Electrical.

See Basic Lab Requirements, paragraph 2-1.4.

2-5 FIGURES.

Figure 2-1 Bubble Diagram Type A Laboratory

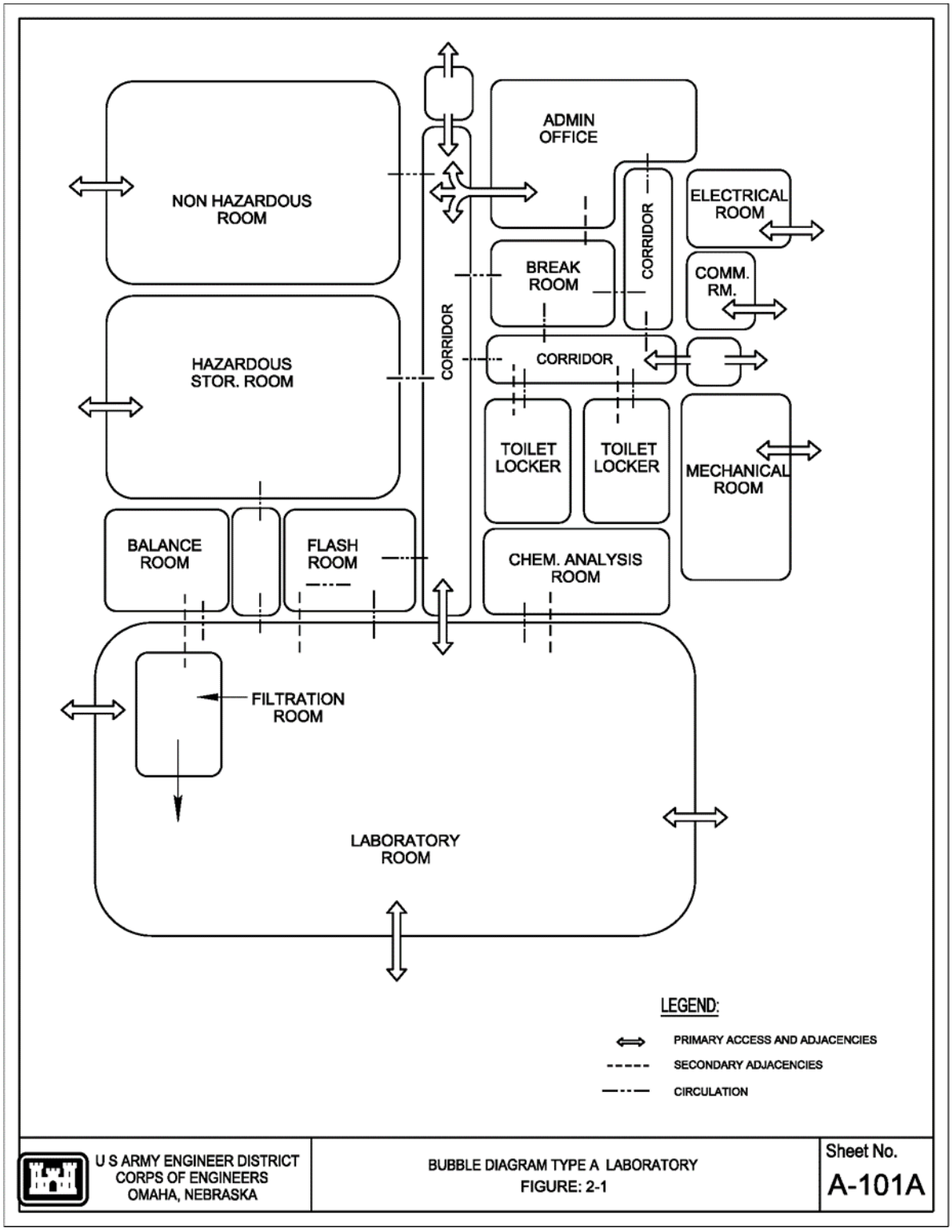


Figure 2-2 Bubble Diagram Type B Laboratory

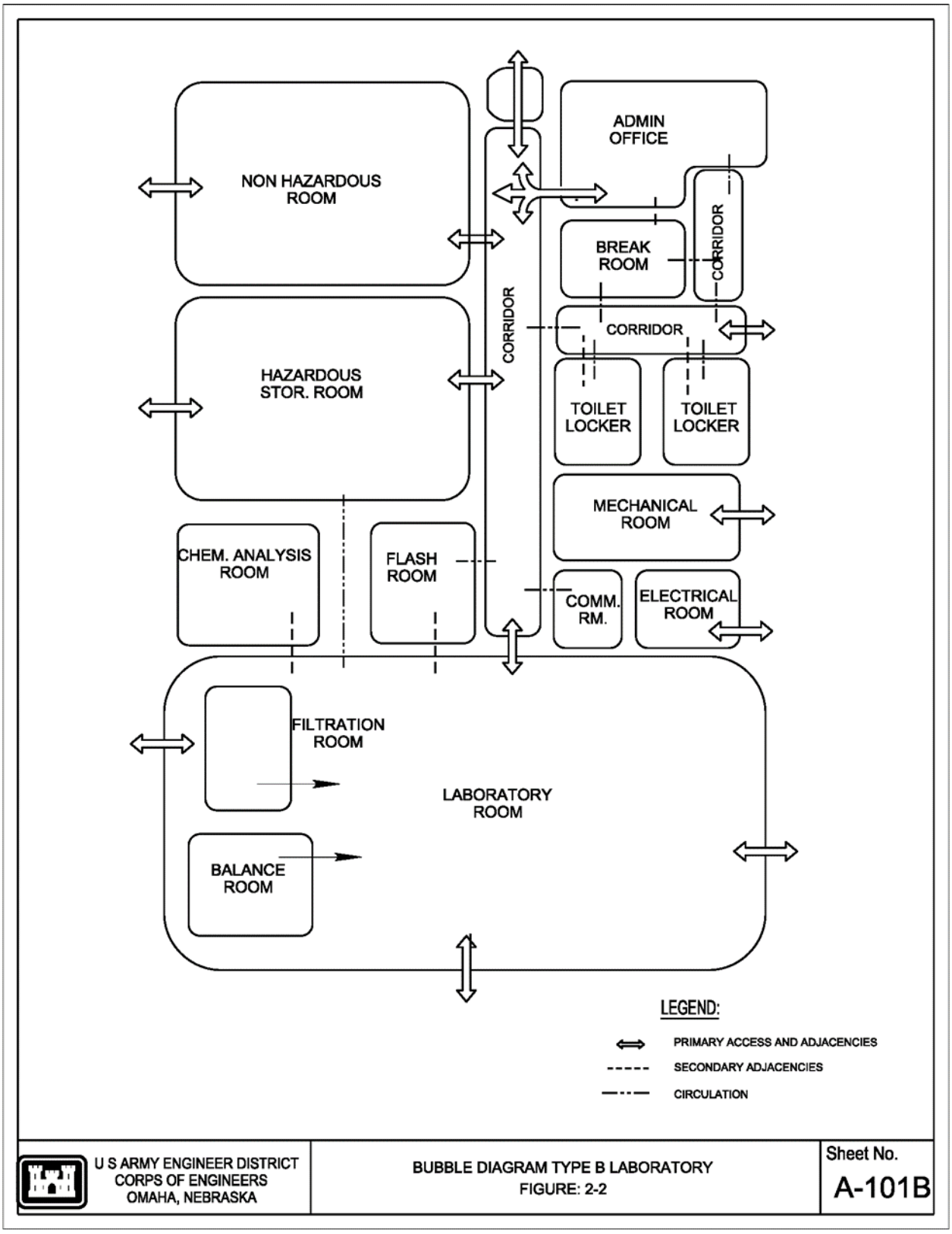
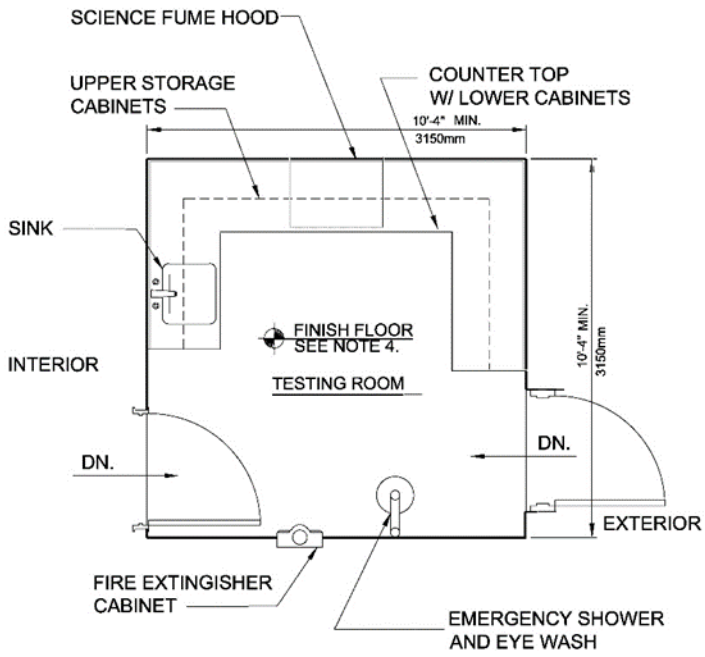


Figure 2-3 Typical C Laboratory Floor Plan



NOTES:

1. INCLUDED IN DESIGN SHOULD PROVIDE SUPPORT SPACES INCLUDING BUT LIMITED TO OFFICE SPACES, MECHANICAL, ELECTRICAL, COMMUNICATION ROOMS, AND TOILET FACILITIES.

2. INTERIOR WALLS MUST BE FIRE RATED A MINUMUM OF 1-HOUR RATED CONSTRUCTION AROUND THE LABORATORY.

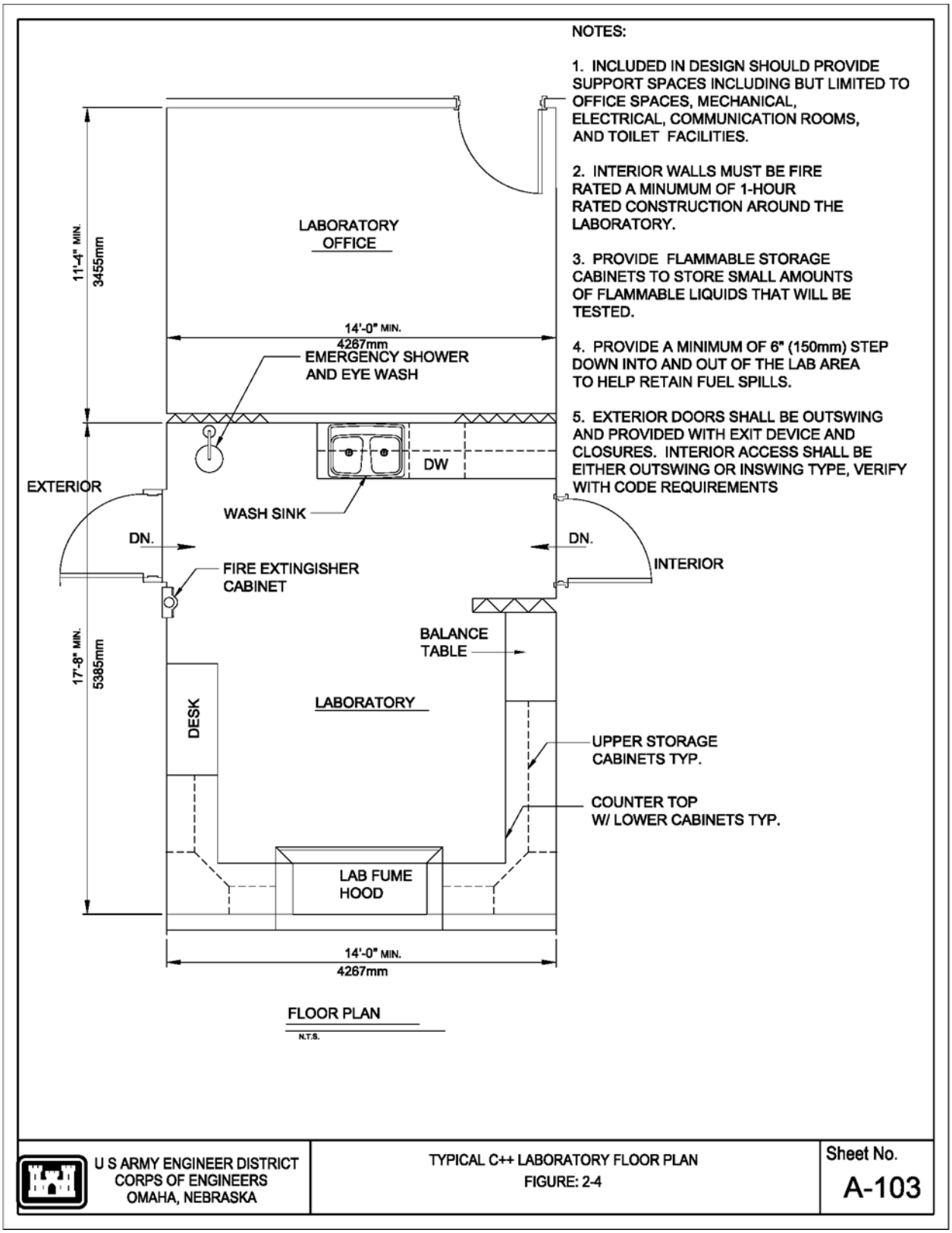
3. PROVIDE FLAMMABLE STORAGE CABINET TO STORE SMALL AMOUNTS OF FLAMMABLE LIQUIDS THAT WILL BE TESTED.

4. FINISH FLOOR OF TESTING ROOM SHALL BE A MINIMUM OF 6" (150mm) BELOW FLOORS IN ADJACENT INTERIOR ROOMS WHEN AN EMERGENCY SHOWER IS INSTALLED.

5. EXTERIOR DOORS SHALL BE OUTSWING AND PROVIDED WITH EXIT DEVICE AND CLOSURE. INTERIOR ACCESS SHALL BE EITHER OUTSWING OR INSWING, VERIFY WITH CODE REQUIREMENTS.

U S ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA	TYPICAL C LABORATORY FLOOR PLAN FIGURE 2-3	Sheet No. A-102

Figure 2-4 Typical C++ Laboratory Floor Plan



2-6 TABLES.

Table 2-1 Fuels Laboratory Equipment Reference

Fuel Type	Test	Counter (Inches)	Good Ventilation or Science Fume Hood	Lab Fume Hood	Vacuum Pump	Comp Air	Natural Gas Propane	Distilled Water	120V*	240V*	Sink	Nitrogen cylinder	Dessicator	Explosion Proof Refrigertr	Testing Oven **	Ice Maker	Bal ***	Test Time Minutes	Lab Type A	B-1	B-2	B-3	C
J E T F U E L	Appearance	30	X															10	X	X	X	X	X
	Color (visual)	20	X															10	X	X	X	X	X
	Density or API Gravity	20	X															20	X	X	X	X	X
	Flash Point ^	36	X				X [4]		X									45	X	X	X	X	X
	Particulate Matter +	36		X	X				X	X			X	X	X		X	170	X	X	X	X	
	Distillation	36	X						X	X	X [5]							90	X	X	X	X	
	Copper Strip Corrosion	36	X						X		X [5]							230	X	X	X	X	
	Freezing Point	30	X							X		X						60	X	X	X	X	
	Existent Gum	48		X		X				X	X		X		X			480	X	X	X	X	
	Vapor Pressure	[1]	X							X	X [5]					X		120	X	X	X	X	
	Water Reaction	30	X					X			X							30	X	X	X	X	
	Lead Content	36	X						X									90	X	X	X	X	
	FSII (& Other Additives) +	30	X					X										60	X	X	X	X	
	Filtration Time	48		X	X				X	X			X		X			170	X	X	X	X	
	Water Separation Index	30	X						X									30	X	X	X	X	
	Conductivity	30	X															10	X	X	X	X	
	Thermal Stability	48	X							X								480	X		X		
	Color (Saybolt)	30	X						X									15	X		X		
	Acid Number	48		X					X		X	X						30	X		X		
	Aromatics	TBD	X															TBD	X				
	Mercaptan Sulfur	TBD	X															TBD	X				
	Net Heat	TBD	X															TBD	X				
	Smoke Point	TBD	X															TBD	X				
	Naphthalenes	TBD	X															TBD	X				
	Hydroperoxides	TBD	X															TBD	X				
	BOCLE	TBD	X															TBD	X				
D I E S E L	Appearance	30	X															10	X	X	X	X	X
	Carbon residue Test	48		X						X								120	X	X	X	X	X
	Cloud Point	[2]	X							X								60	X	X	X		
	Pour Point	[2]	X							X								60	X		X		
	Copper Strip Corrosion	36	X						X		X							170	X		X		
	Cetane Index	N/A	X															10	X		X		
	Viscosity	48	X							X								120	X		X		
	H20 & Sediment/Centrifug	36	X						X									30	X		X		
	Particulate Contamination	36		X	X				X	X			X		X			170	X		X		
	Ash	TBD	X															TBD	X				
	Aromatics	TBD	X															TBD	X				
	Sulfur	TBD	X							X								TBD	X		X		
	Lubricity (HFRR)	TBD	X															TBD	X				
M O G A S	Appearance	30	X											X				10	X	X	X	X	X
	Vapor Pressure	[1]	X							X	X			X				120	X	X	X		
	Unwashed Gum	48		X		X				X	X		X	X	X			480	X		X	X	
	Oxidation Stability	[3]	X						X		X			X				480	X		X		
	Lead Content	36	X						X					X				360	X			X	

* Power supply voltage may vary by region and equipment requirements
[1] bath mounted on floor, 30 inches wide, 32 inches above ground
** two ovens required: a general oven for drying glassware and a separate oven for performing tes [2] mounted on floor, 48 inches wide
*** Balance to be located in an area isolated from air movement, perhaps a separate room [3] mounted to floor-standing platform (platform extends 1' above floor), bath sits on platform and is 1' square and 2' high
^ consider additional ventilation (fume hood, snorkel, spot ventilation) as recommended in ASTM [4] propane is normally provided with the test equipment, propane canister
+ additional test AF labs perform, designated (C++ Lab) [5] drain from equipment to sink or floor drain required
Note to designer: verify order of sampling and proximity to emergency eyewash/shower, electrical supply, fume hood, etc. to optimize safety and functionality

Table 2-2 Possible Products in a Flammable Storage Room

Note: This is not an all-inclusive list. In addition, fuel samples and other products may be used and stored in a typical Flammable Storage Room for DoD Fuels Laboratories.

PRODUCT CATEGORY	PRODUCT NAME
ALCOHOL	ETHANOL, ABSOLUTE
	ETHANOL, Denatured
	ISOPROPANOL
	METHANOL
SOLVENTS	
	TOLUENE
	TOLUENE HPLC Grade Certified
	PETROLEUM ETHER
	HEXANE
	HEXANE 99% Purity
	ISOOCTANE
	HEPTANE
	PENTANE
	ACETONE
	ACETONE High Grade
	XYLENE
	NAPTHA
	STODDARD SOLVENT
	DRYCLEANING SOLVENT
	LANCER ACID for Dishwasher
	LANCER CLEAR for Dishwasher
PETROLEUM PRODUCTS	FUEL & PACKAGED PETROLEUM PRODUCTS - VARIOUS

APPENDIX A REFERENCES

AMERICAN SOCIETY OF HEATING, REFRIGERATION, AND AIR CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1, *Ventilation for Acceptable Indoor Air Quality*

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ANSI/AIHA/ASSE Z9.5, *Laboratory Ventilation*

UNIFIED FACILITIES CRITERIA

http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 1-200-01, *DoD Building Code*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

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

UFC 3-420-01, *Plumbing Systems*

UFC 3-460-01, *Design: Petroleum Fuel Facilities*

UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*

UFC 3-575-01, *Lightning and Static Electricity Protection Systems*

INTERNATIONAL BUILDING CODE (IBC)

IBC, as modified by UFC 1-200-01

ARTICLE I. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*

NFPA 70, *National Electrical Code®*

NFPA 780, *Standard for the Installation of Lightning Protection Systems*

ARTICLE II. U.S. DEPARTMENT OF DEFENSE (DoD)

DOD 4140.25M, *DOD Management of Bulk Petroleum Products, Natural Gas, and Coal*

MIL-STD 3004, *Quality Assurance/Surveillance for Fuels, Lubricants and Related Products*

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APPENDIX B GLOSSARY

B-1 ACRONYMS AND ABBREVIATIONS

AF	Air Force
AFCEC	Air Force Civil Engineer Center
BIA	Bilateral Infrastructure Agreement
CONUS	Continental United States
DAF	Department of the Air Force
DoD	Department of Defense
EMC	Electrical Metallic Conduit
FLC	Fleet Logistics Center
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
HVAC	Heating, Ventilating and Air Conditioning
IMC	Intermediate Metallic Conduit
LED	Light-Emitting Diode
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MDP	Main Distribution Panel
MTS	Manual Transfer Switch
NAVFAC	Naval Facilities Engineering Command
OSHA	Occupational Safety and Health Administration
PVC	Polyvinyl Chloride Conduit
SOFA	Status of Forces Agreements
UFC	Unified Facilities Criteria
UL	Underwriter’s Laboratories
U.S.	United States

B-2 DEFINITION OF TERMS

Sash Operating door on lab fume hood