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UNIFIED FACILITIES CRITERIA (UFC)

AIRCRAFT CORROSION CONTROL AND PAINT FACILITIES

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UNIFIED FACILITIES CRITERIA (UFC)

AIRCRAFT CORROSION CONTROL AND PAINT FACILITIES

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

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

Change No.	Date	Location

This UFC supersedes UFC 4-211-02NF, dated 10 January 2005, with Changes 1-4.

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 should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet sites 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://dod.wbdg.org/.

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

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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Document: UFC 4-211-02, *Aircraft Corrosion Control and Paint Facilitie*s

Superseding: UFC 4-211-02NF, *Corrosion Control and Paint Finishing Hangars*, dated 10 January 2005, with Changes 1-4

Description: This UFC provides criteria for the planning and design of Aircraft Corrosion Control and Paint Finishing (ACCPF) Facilities for the aircraft of the combined DoD United States Armed Forces.

Reasons for Document: This is a new Joint Service document. This new document represents another step in the Joint Services effort to bring uniformity to the planning, design and construction of military facilities. This UFC was developed to provide design requirements to accomplish the following:

- Assist planners in understanding the facility requirements to ensure accurate space programs and budgets.
- Provide architects, engineers, and construction surveillance personnel with the essential, minimum requirements for the design and construction of Aircraft Corrosion Control or Paint Finishing Facilities.
- Clarify the operational intent of the facility design.

Impact: The following will result from the publication of this UFC:

- This UFC creates a single source for common DoD ACCPF criteria and an accurate reference to individual Service-specific documents.
- This UFC facilitates updates and revisions and promotes agreement and uniformity of design and construction between the Services.

Unification Issues: The following are issues that remain non-unified and the reasoning for each:

- Section 2-1 identifies Service-specific documents for corrosion control requirements. The documents detail Service-specific aircraft corrosion control maintenance procedures and practices that may affect the facility design and are noted for reference.
- Section 2-5.3 identifies different minimum clearances and working space allowances. The exception is based on Service operational requirements for aircraft movement near fixed objects. The exception has little impact on Corrosion Control hangar size, since operational clearances control the size of the hangar bay.
- Sections 3-2.2.1, 3-4.3 and 3-6 identify different Service-specific Fire Protection requirements. These requirements are not currently unified by Fire Protection Working Group. These issues will be discussed in developing unified requirements for General Maintenance Hangars in the near future.

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CHAPTER 1 INTRODUCTION

1-2 SCOPE OF DOCUMENT.

This UFC provides requirements for evaluating, planning, programming, and designing Aircraft Corrosion Control and Paint Facilities (ACCPFs). The information in this UFC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental Unites States (CONUS) and outside the continental US (OCONUS). The requirements contained in this UFC apply to Army, Navy, Marine Corps and Air Force facilities unless specifically referenced to a single service. This UFC is not intended as a substitution for thorough review during design by individual Program Managers and Operations Staff in the appropriate Service.

1-3 APPLICABILITY.

This UFC provides planning and design criteria applicable to new construction as well as sustainment, restoration and modernization projects on all Department of Defense (DoD) facilities in the continental United States, (CONUS), and outside the continental United States (OCONUS).

1-3.1 General Building Requirements.

Comply with UFC 1-200-01, General Building Requirements. UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, sustainability, and safety. The design requirements in this UFC are to be used in addition to UFC 1-200-01 and referenced UFC's and criteria.

1-4 SCOPE OF FACILITY.

ACCPFs provide space, infrastructure and support facilities to conduct de-paint, paint, and corrosion control activities for DoD aircraft. There are three categories of facilities:

- Depot Facilities (DF) support comprehensive de-paint and paint programs. These facilities may operate almost continuously in support of the corrosion control program.
- Corrosion Control Facilities (CCF) support periodic activities on an as-needed basis. In the past, these facilities have also been called operational/intermediate level facilities, squadron level, field level, and patch and paint facilities.
- Wash Racks fulfill the requirement of periodic corrosion control on aircraft not requiring remedial corrosion maintenance. Wash Racks may be open, covered, enclosed, or integrated into the hangar bay, but the functions performed and the utilities provided at the Wash Rack are limited to the washing and rinsing of aircraft.

The ACCPFs described in this document are indicated in Figure 1-1. A comprehensive list of functional program spaces are listed and described briefly in Table 1-1 and described in greater detail in Chapters 2 and 4 through 7

FIGURE 1-1. ACCPF FACILITIES

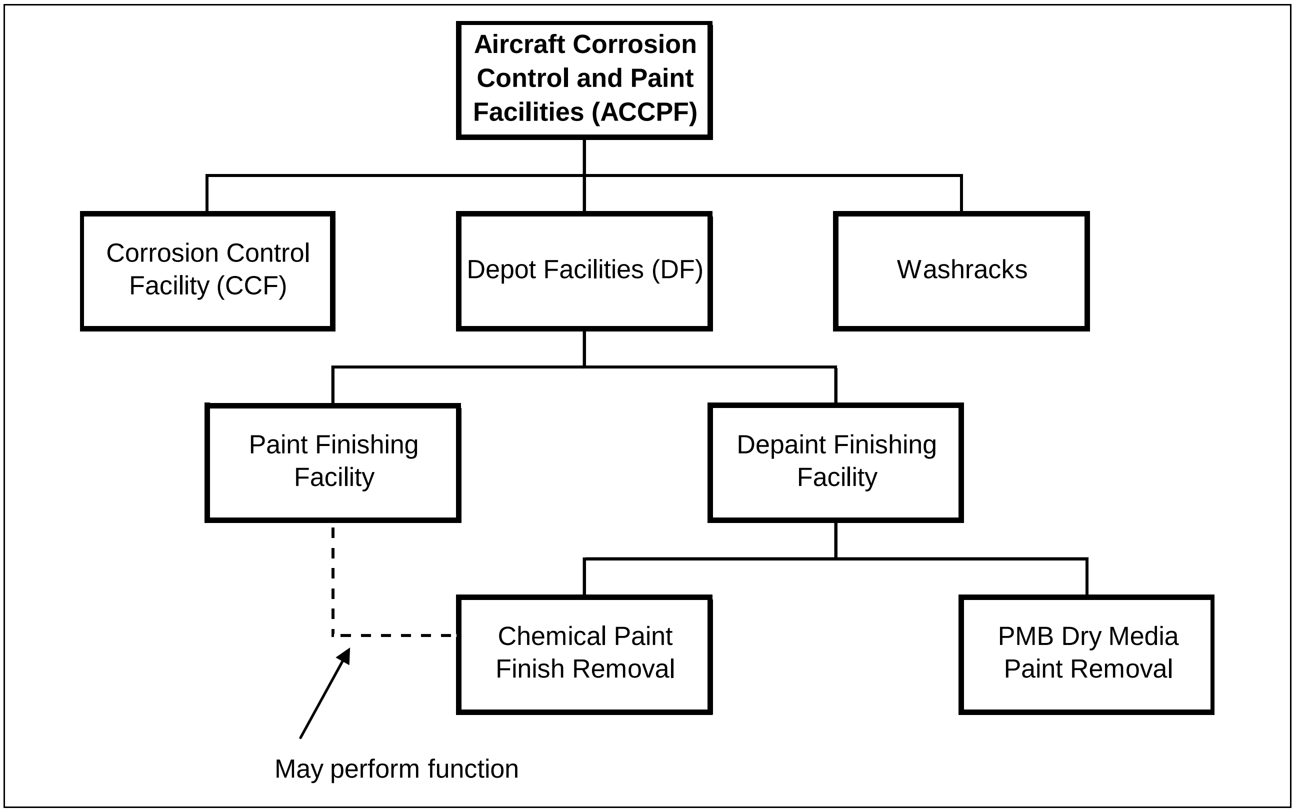

TABLE 1-1. ACCPF FUNCTIONAL PROGRAM AREAS

Functional Program Area	Description
Operational Spaces	
Aircraft Hangar Bay (Paint/Wash/Chemical Depaint)	Houses aircraft and equipment anticipated for the mission of Facility. The bay must be sized for the largest aircraft with additional space for anticipated maintenance platforms and equipment. The bay should also include utility connections required for the mission. Utilities will vary for paint application, and chemical depaint versus dry depaint.
Aircraft Hangar Bay (Dry Media Depaint)	Houses aircraft and equipment anticipated for the mission of Facility. The bay must be sized for the largest aircraft with additional space for anticipated maintenance platforms and equipment. The bay must be designed for a dusty environment and include strategically placed outlets for Dry Media Blast (DMB) distribution and spent DMB pick up /delivery system for DMB reclamation; with additional utilities specific for the mission.
Paint Mix Room	Coating mix and paint pot staging; should be adjacent to paint storage with easy access to paint bay.
Paint Storage Room	Aircraft coating container storage; adjacent to paint mix, with curbed storage area drained to I.W.; should also have access for deliveries.
Tool Crib	Special use equipment tools such as pallet jacks, ladders, facility maintenance items.
Equipment Storage	Paint application equipment storage; typically combined with paint equipment cleaning room.
Equipment Cleaning	Paint application equipment cleaning; room generally contains small paint booth or other solvent cleaning apparatus for use with paint spray guns and paint pots.
Solvent Storage	Large container (typ. 55 gal) paint solvent storage; requires pallet storage with door openings and aisles suitable for deliveries.
Central Acid Storage	Central storage for acid cleaner and conversion coating; may include central chemical mix and storage tanks with pumps and piping for distribution to the hangar bay.
Central Chemical Storage	Central storage/distribution for hot soap/water mix and hot and cold water; typically includes bulk storage of concentrated soap, central hot water heater/tank, soap/HW mix tank and associated distribution pumps.
Material Storage	Secure storage of non-hazardous paint prep materials; typically includes a window for distribution of materials to paint personnel; may also include storage of paint process equipment and parts.
PPE Storage	Room/area designated for secure storage of PPE; storage of PPE is typically combined with PPE cleaning.
PPE Cleaning	Cleaning of personnel protective equipment; typically includes divided sinks; central washer and drier (optional).
Paint Booth	Individual paint spray booth for small parts (may be located inside hangar bay or exterior to building).

TABLE 1-1. ACCPF FUNCTIONAL PROGRAM AREAS

Functional Program Area	Description
Operational Spaces (cont'd)	
Stencil Room	Houses aircraft stencil equipment; room size should consider size of aircraft stencils as well as equipment.
Composite Room	Composite/fiberglass layup/repair room will typically contain work benches with ventilation hoods, and curing ovens for repair of composite parts.
Dry Media Equipment Room	Centralized dry blast media retrieval, processing and distribution equipment
Dry Media Storage Room	Bulk dry media storage (palletized)
Dry Media Blast Booth	Fully enclosed self -contained room specifically designed with the equipment and utilities for the removal of coatings by the DMB method, generally manually performed by a DMB nozzle operator stationed inside the booth.
Wash Rack	Accommodates aircraft cleaning and can be open, covered, enclosed, or integrated into the hangar bay.

Administrative Spaces	
Supervisor's Office	Private office located with view of hangar bay
Offices	Private offices and/or workstations determined by mission requirements
Conference Room	Small assembly with conference table and chairs
Fax/Copy	Centralized fax/copy room
Break Room	Personnel break and assembly room
Locker Rooms (clean)	Male and female locker/shower/toilet facilities
Locker Rooms (dirty)	Male and female lockers used for disposition contaminated clothing worn by operators during the performance of their corrosion control duties
Technical Library	Storage of aircraft technical documents
Maintenance Shops (option)	Optional mission-specific maintenance spaces
Support Spaces	
Mechanical Room(s)	HVAC and miscellaneous mechanical systems
Compressor Room	Plant air and breathing air compressor systems .Note specific requirements for Breathing Air vs. Plant Air
Central Plant	Centralized chilled water and heating hot water supply
Electrical Room(s)	Switchboards, motor control centers, distribution transformers, circuit breaker and lighting panels, VFD equipment
Fire Protection Room	Fire water riser, distribution manifold, AFFF or HEF storage tanks
Communication Room(s)	Telephone switchboard and misc communications equipment

Note: All spaces listed above in Table 1-1 are examples of spaces common to DFs and CCFs. Actual spaces included in the planning phase must be based on the specific mission of the facility.

1-5 FACILITY PROJECT TEAM.

The planning and design team for ACCPF must include the following specialists in addition to the standard architecture and engineering disciplines:

- Aircraft Corrosion Control and Prevention Operations
- Aircraft Maintenance Operations
- Industrial Hygiene
- Environmental Quality and Protection
- Safety
- Fire Marshall
- Facility Maintenance
- Energy Manager
- Flight line and AT/FP Security

1-6 PROGRAM AUTHORITIES.

Prior to project development, confirm the acquisition methodology and coordinate facility requirements with the following contacts for the appropriate Service:

- Army. Aviation and Missile Command Corrosion Program Office
- Air Force. AF Corrosion Prevention and Control Office (AFCPCO)

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CHAPTER 2 PLANNING AND LAYOUT

2-1 FACILITY FUNCTION.

Design the corrosion control hangar to provide space and equipment for the specific corrosion control functions required by the project mission. These corrosion control functions can be performed at either a DF or CCF.

In general, base facilities designed for DF perform de-paint/re-paint maintenance on the entire aircraft. Base facilities designed for CCF perform de-paint/re-paint maintenance on repaired or replaced components only. Service-specific corrosion control requirements are defined in the following documents:

- Army and Navy. NAVAIR Technical Manual NAVAIR 01-1A-509-1, *Cleaning and Corrosion Control*
- Air Force. *Air Force Corrosion Control Facility Reference Guide*

Aircraft Corrosion Control Facilities, as a whole, encompass the following functions:

- Aircraft washing
- Repair and Touchup Painting
- Full Aircraft Repainting
- Finish Curing and Drying
- Depaint (Chemical and Dry Media)
- Component painting
- Paint mixing
- Chemical/paint storage

2-1.2 Depot Level Facilities.

The primary function of a Depot Level Paint or De-paint Facility is to provide the necessary space and services to perform complete corrosion control activities on aircraft undergoing scheduled major maintenance checks or a scheduled complete corrosion control repaint. Depot level facilities must be capable of providing complete services required for all operations involved with the total paint, or de-paint of an entire aircraft. While chemical de-paint operations are often performed in a depot level Paint Facility, Dry Media Blast operations must be performed only in facilities specifically designed and built for the DMB de-paint function.

2-1.3 Corrosion Control Facilities.

The primary function of a Corrosion Control Facility is the performance of minor corrosion control activities in support of an active squadron as part of non-scheduled maintenance completed on an as needed basis. Corrosion Control Facilities, in general, must be able to perform all the functions listed above with the exception of the DMB De-paint. As noted above in 2-1.1, the DMB De-paint function should be reserved for a Depot Level Facility. The planner should also be aware that if the mission of the CCF includes the requirement to repaint an entire aircraft or any part of the aircraft, airflow requirements in the CCF paint bay will be the same as the Paint Finishing (Depot Level) Hangar.

In some cases, the mission of the CCF may require special functions such as composite or sheet metal repair. Extra shops will be needed for the completion of these tasks.

The primary difference then between the DF and the CCF is the projected aircraft throughput versus the necessity for operational flexibility.

Table 2-1 ACCPF PLANNING ISSUES, below provides the different functional issues which must be considered when planning a CCF or DF which must fulfill the mission requirements, and also be safe, cost effective, energy efficient, and environmentally compatible.

TABLE 2-1. ACCPF PLANNING ISSUES

Planning Issue	**CCF**	**DF**
GENERAL	*Low Aircraft Throughput *Greater Process Variety *Shorter Process durations *Increased Downtime *Limited Number of Personnel *Fueled aircraft	*High Aircraft Throughput *Limited Processes required *Longer Process durations *Minimum Downtime *More Personnel Involved *Defueled and purged Aircraft
SPACE PLANNING	Consider number of hangar bays WRT aircraft throughput & operation specialization. Lower personnel = lower area required for amenities. Higher number of processes = higher number of specialty spaces (Back shops)	Consider number of hangar bays WRT aircraft throughput and processes performed. High personnel reqs = large area needed for amenities. Minimum specialized processes = fewer number of Back Shops.
HVAC DESIGN PLANNING	Increased downtime allows for use of prevailing weather to provide window of opportunity for correct Temp/ humidity conditions. Heating only systems typical. Horizontal air flow offers flexible, economic Supply Air design.	24/7 type operations with minimum downtime call for full temp./ humid. HVAC Systems. Exhaust Recirc + add'l energy recovery systems should be considered. Downflow Air Supply an option; offers high quality "Auto" finish; with fast production for hangars designed for single aircraft.
FACILITY ENVIRONMENTAL	Air: Consider air emissions WRT overall Base Permit.	Air: Consider air emissions WRT overall Base Permit.

TABLE 2-1. ACCPF PLANNING ISSUES

Planning Issue	CCF	DF
IMPACT	Water: Consider Industrial Waste (IW) treatment requirements wrt existing base capabilities and capacity	Water: Consider increased and special CCF Waste treatment reqs. with respect to existing base capacity, and possible need for a new WT system required for pretreatment of IW effluent
MECHANICAL EQUIPMENT REPAIR & REDUNDANCY	Increased available hangar downtime allows for less critical timing for repair/replacement of failed systems.	Longer processes, low available downtime mandate an increased level of redundant equipment.
FIRE PROTECTION	AFFF, HEF and/or DELUGE FP systems required for facilities housing aircraft with any fuel on board.	Typical installation for defueled and purged aircraft requires a closed head sprinkler FP system
WORKER ACCESS/SAFETY	Fewer personnel, shorter processes call for minimal number of Ceiling supported man lifts, high use of ground supported man lifts and maintenance stands	Higher number of personnel with longer processes call for higher density of Ceiling & ground supported man aboard systems
	Fall Protection required.	Fall Protection required.
	Change Rooms, Lockers, Showers and Contamination Control required.	Change Rooms, Lockers, Showers and Contamination Control required.

2-1.4 Wash Racks.

The variety of wash racks are as follows and are discussed in greater detail in UFC 3-260-01, *Airfield and Heliport Planning and Design*:

a. Open (uncovered) Wash Rack – an open air paved area specifically designed for the manual washing of aircraft. This facility should include wash utilities, drainage capability for both storm water and wash water waste, and may include lighting and power outlets for night operations, depending on the mission.

b. The Covered Wash Rack – The Covered facility will provide the same capabilities as noted above in Item A. with the added benefit of a non-climate controlled roof structure, typically with open sides. The covered facilities are used primarily to keep aircraft out of direct sun to reduce the skin temperature and improve wash conditions.

c. Interior Wash Racks –Interior Wash Racks for the purpose of this document will be considered fully enclosed environmentally controlled facilities with all utilities required for the washing of aircraft. The DF (Paint) and CCF as described in this document are required to provide all services for the Interior Wash Rack. Please refer to the appropriate DF and CCF sections for those requirements.

d. Birdbaths (Aircraft Rinse Facility) – An Aircraft Rinse Facility referred to as a ”Birdbath” provides an unattended taxi-through treadle-operated freshwater deluge system to rinse aircraft typically subjected to accelerated corrosion due to low-level over water operations or a corrosive atmosphere at the installation.

2-1.5 Multi-Use Facilities.

Multi-use facilities, for the purpose of this document, refer to ACCPF that include functions outside the family of corrosion control, such as Fuel Cell or Maintenance activities. This document does not address those functions outside the corrosion control capability nor the special requirements those functions may impose on an ACCPF facility.

2-1.6 Technical Complexity of Ventilation Systems

Corrosion control facilities normally require complex, and expensive ventilation systems in order to comply with applicable environmental, fire protection, and occupational health requirements. It is essential that the system requirements and costs are identified during the project development and are included on the DD Form 1391.

The DD Form 1391 should also note that the facility requirements include the mandatory need for mechanical ventilation to remove paint particulates and solvent vapors. The inclusion of this statement, as well as including the costs for the system (including the acceptance test and associated report), as a separate line item in the facility cost estimate will help ensure that adequate funds are allocated for this extremely costly requirement. An example of a statement that might be included on the DD Form 1391 is shown below:

“Mechanical Ventilation is required to remove paint particulate and solvent vapors from the Corrosion Control Facility. Upon facility completion, an independent ventilation expert must evaluate the effectiveness of the mechanical ventilation system. The ventilation expert must provide a detailed evaluation report with recommendations regarding system acceptance and corrective action for discrepancies”.

2-1.7 Equipment Planning Issues.

It is imperative that all operational equipment anticipated for use in the new facility be identified and programmed early in the planning process in order to ensure the provision of adequate space and utilities in the facility design.

2-2 LOCATION DETERMINANTS.

2-2.1 Geographical Location

The location of a Depot Level and Corrosion Control Facility is generally predetermined by mission requirements, and climate is typically not a determining factor in location selection. Climate, however, has a significant effect on the design, energy usage and operational constraints of the facility. As part of the statement(s) which will go into DD Form 1391 regarding the mechanical ventilation system (ref. paragraph 2-1.5, above), the steps outlined in Section 2-3 HVAC System Selection must first be followed to determine the level, complexity and estimated cost of the proposed hangar bay HVAC system required to meet the mission of the facility.

2-2.2 Site Orientation.

Consider the prevailing wind in orienting the building in relation to aprons, taxiways, and parking, to avoid exhaust air dispersal over areas affected by solvent vapors and to avoid recirculation into the ventilation system intakes.

Orient hangar such that it complies with all geometric requirements of UFC 3-260-01.

2-2.3 Site Organization.

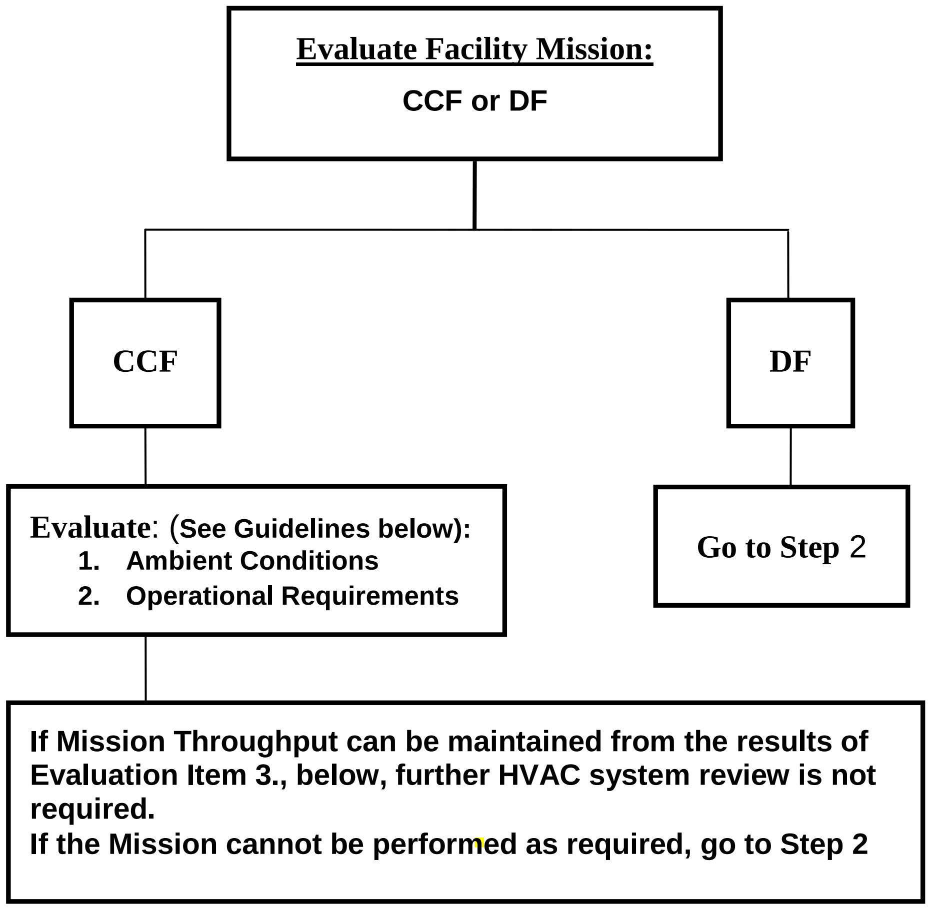
Locate the corrosion control hangar in close proximity to the maintenance hangars and as close as possible to an aircraft wash rack. Access between the corrosion control hangar, the maintenance hangar, and the aircraft wash rack is required. Locate the paint-finishing hangar with due regard to the requirement for aircraft and vehicle access.

2-3 HVAC SYSTEM PLANNING & SELECTION.

Non-process areas of hangars must meet all energy efficiency goals. Process areas must meet energy goals as much as practical. Systems also must conform to the latest service-specific policies for energy efficiency. See Chapter 3 for design applications and requirements for specific HVAC systems. For the initial facility planning phase, use the following steps in selecting the HVAC system for the Hangar Bay which will house the aircraft spray painting operations.

STEP 1. Define the facility mission to determine facility type (CCF vs. DF) and process requirements to establish HVAC objectives per Figure 2-1.

FIGURE 2-1. HVAC SYSTEM SELECTION STEP 1



1. CCF Baseline is 100% OA. See UFC 3-400-02 for dry bulb & humidity parameters: MEL, MEH@2%, MEH@97.5%, HR@2%. Evaluate need for heating for operations (~75 deg F [23.9 C]) and freeze protection based on ambient conditions. Also evaluate need for heat recovery.

2. Evaluate the operational requirements for temp and humidity and compare to the ambient conditions.

3. Establish the effect of 1. & 2 on the Mission Performance and Throughput

STEP 2. Identify requirements for interior conditions of the process hangar bay per Figure 2-2.

FIGURE 2-2. HVAC SYSTEM SELECTION STEP 2 TEMPLATE

Process Mode	Interior Conditions					
	% Usage Per Year	TEMP (F)*		RH*		Air Flow Requirements
		Max	Min	Max	Min	
Unoccupied						
Paint Prep						
Paint Removal						
Pre-treatment						
Paint						
Cure						
Min-Occupancy						

* Interior Conditions must be based on the more stringent of 1) coating manufacturer's temperature and relative humidity requirements or 2) personnel heat stress limitations per Chapter 3, Mechanical.

STEP 3. Establish a baseline HVAC System which represents the lowest perceived capital first cost that fulfills the requirements of Step 2. Based on the baseline system, develop an energy budget for each process. Service specific guidelines and the minimum guidelines of ASHRAE 90.1 must also be followed for auxiliary spaces.

Note that during the development of the energy budget, consideration should be given to utilization of the ambient conditions as much as possible during processes which require large amounts of outside air.

STEP 4. Analyze alternative HVAC systems and/or energy conserving methods as determined appropriate for the application as potential additions or alternatives to the baseline system. Examples of alternative systems or methods include recirculation, heat recovery, and ice storage.

With the emphasis on energy conservation along with recent improvements in mechanical system technology, recirculation of ventilation air is now being recognized as an accepted alternative to improving energy efficiency in a spray paint environment. The effectiveness of recirculation in reducing energy usage can vary widely depending upon climate. In locations where much energy is expended to keep the temperature and humidity of the facility within operational parameters, recirculation may be easily justified from an economic perspective. In very temperate climates, the mechanical complexity and additional equipment required for a recirculated ventilation system may negate the climate control savings advantage. It is important to evaluate the economic impact of recirculation over time based on anticipated energy savings. Also included in the evaluation for determination of exhaust air recirculation are the OSHA regulatory issues related to personnel safety and the required monitoring of the ventilation air and operations personnel.

STEP 5. Establish the potential Life Cycle Cost Analysis (LCCA) benefit to the project and select system with the lowest Life Cycle Cost (LCC) which fulfills current occupational safety, health, energy efficiency, and other related standards for the facility's process spaces.

2-4 LAYOUT AND ADJACENCIES.

2-4.1 General Building Layout and Adjacencies.

The appropriate building layout and adjacencies are illustrated in Figures 2-3 and 2-4. These diagrams do not convey a building shape. Figures 2-3a and 2-3b represents the DF and Figure 2-4 represents the CCF. Figure 2-5 provides a schematic representation of the personnel flow from the "dirty" or "hot" hangar bay areas and the "clean" or "cold" areas. This is to prevent any contamination from the cleaning, depainting or painting agents used in the hangar bay reaching the clean areas where protective equipment is not required.

Arrange work-bays so that each has ready access to the outside and to equipment and storage spaces of the hangar. Isolate work-bays in which cleaning and stripping are done from work-bays in which painting and curing are done. Administrative spaces such as work control offices may be accommodated in mezzanines. Provide mechanical equipment rooms with outside access. "Break" rooms must be on "clean" side, but areas can be included on "dirty" side for brief breaks without eating.

FIGURE 2-3a. DF PAINT & CHEMICAL DEPAINT BUBBLE DIAGRAM

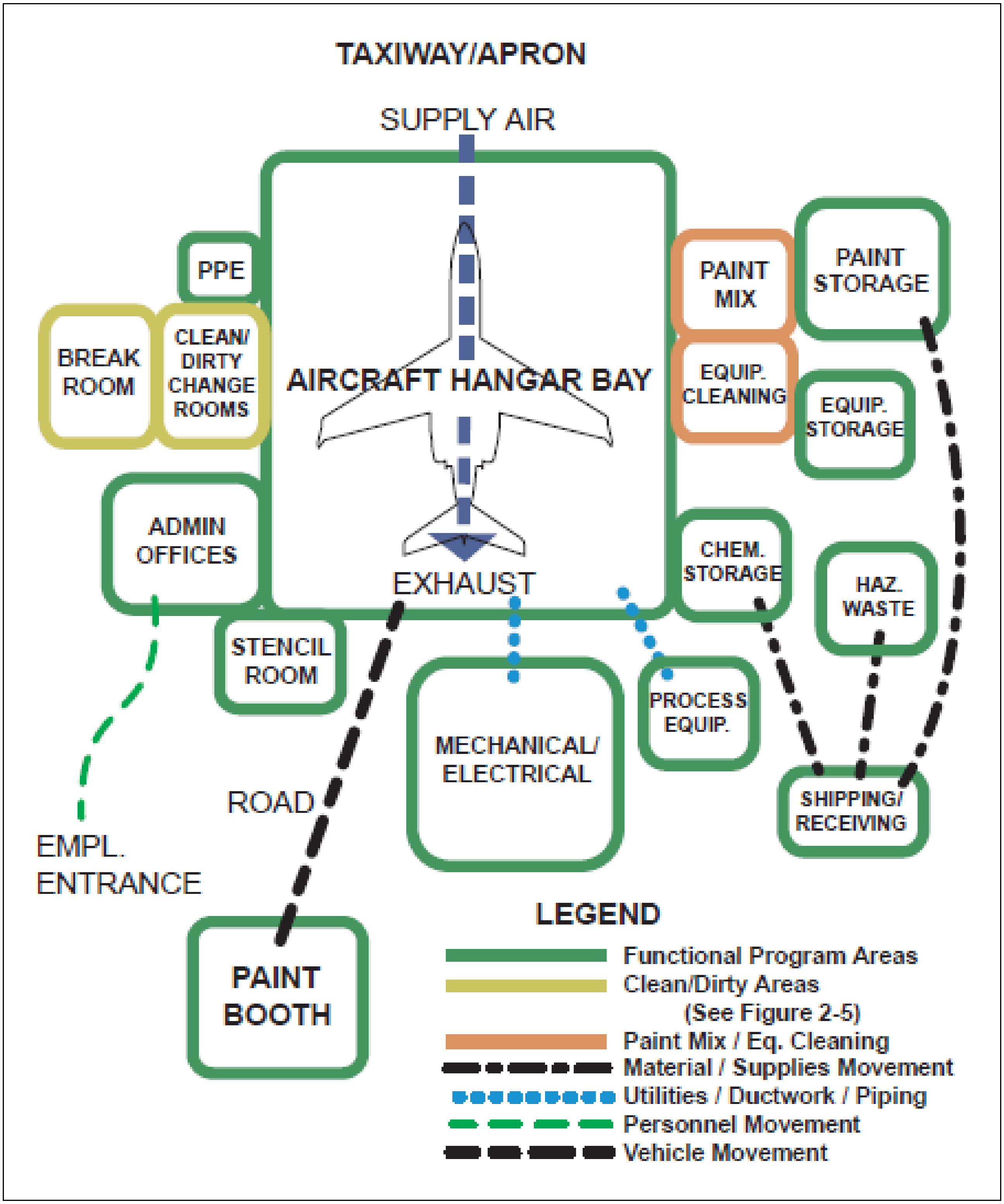


FIGURE 2-3b. DF DRY MEDIA DEPAINT BUBBLE DIAGRAM

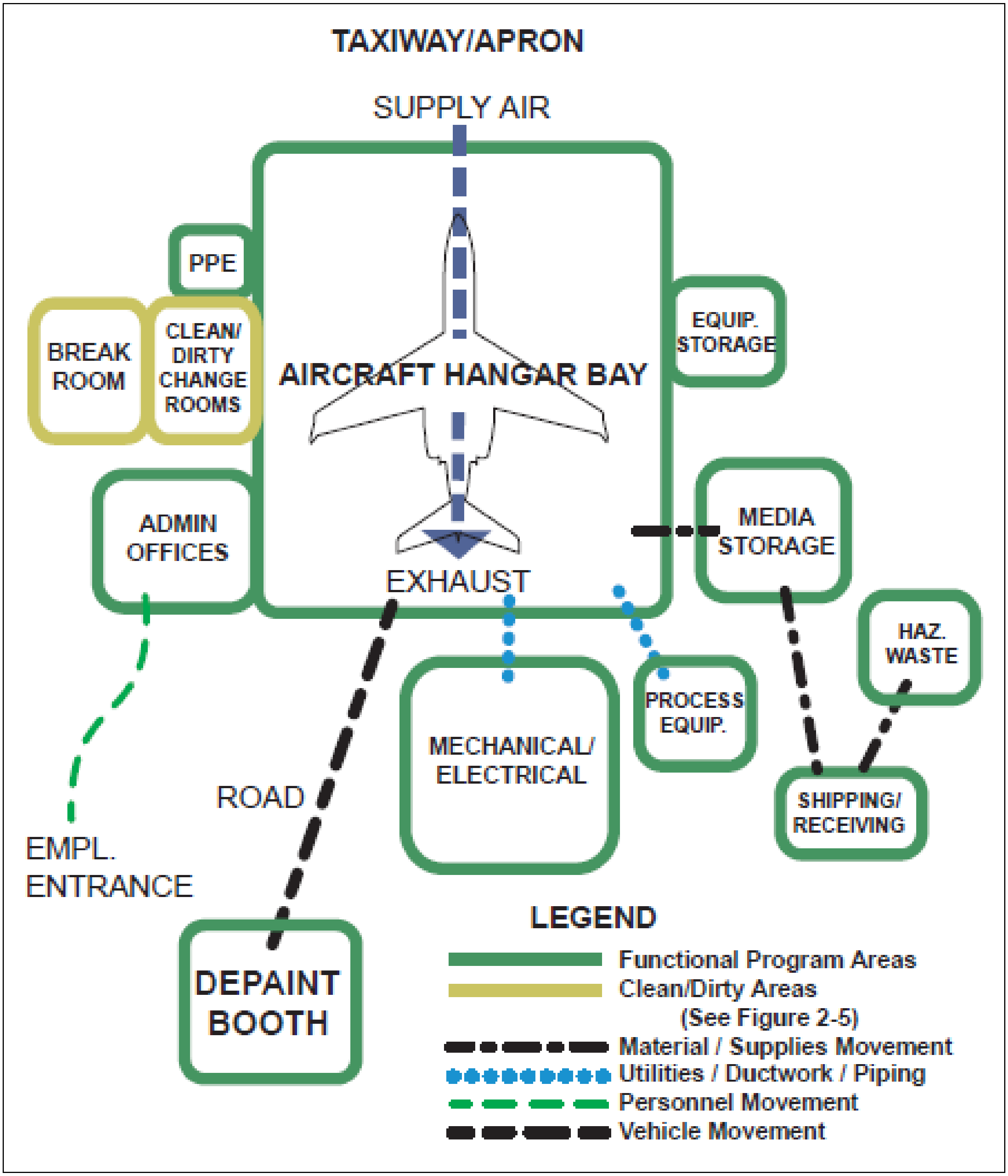


FIGURE 2-4. CCF BUBBLE DIAGRAM

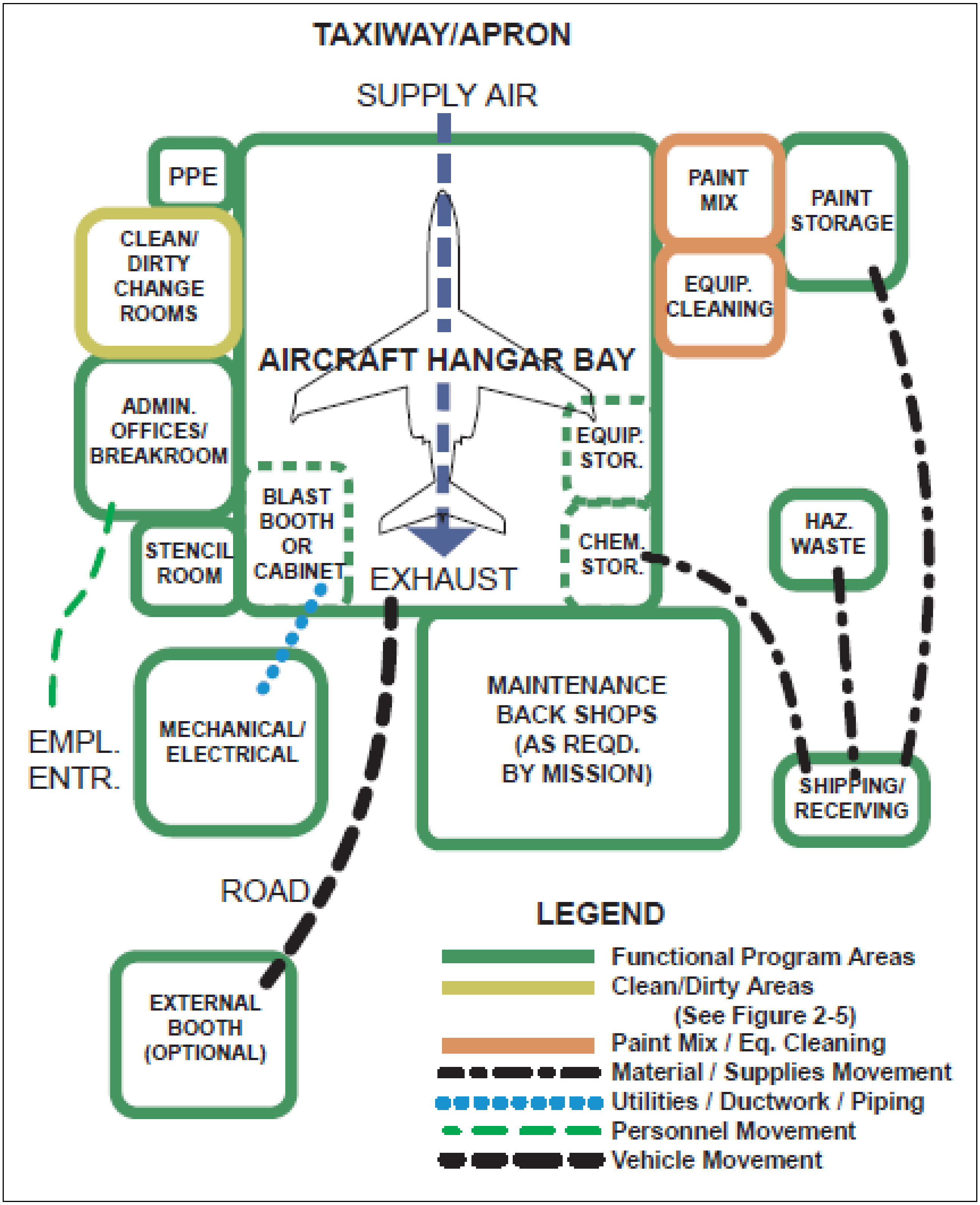
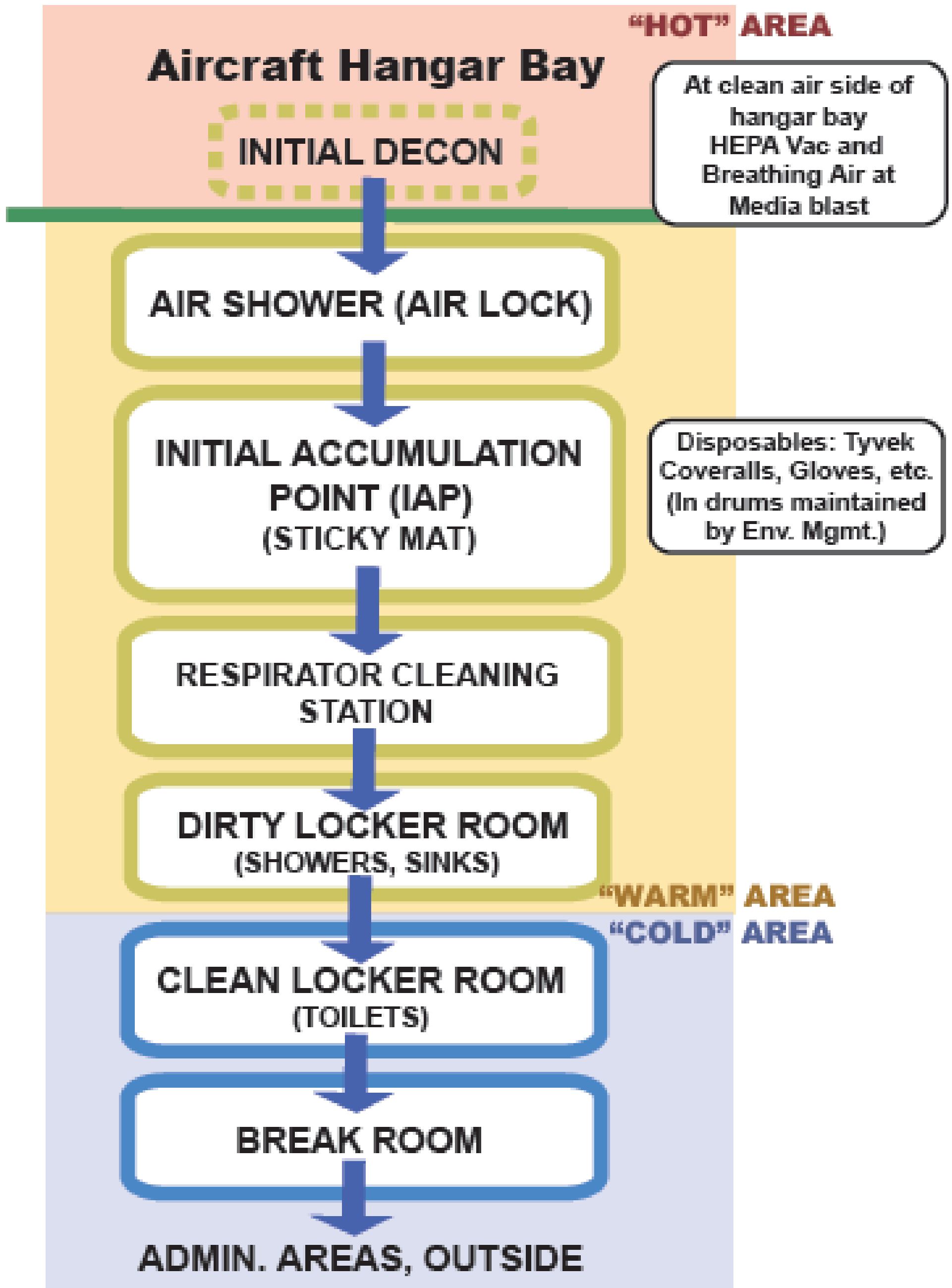


FIGURE 2-5. CLEAN-DIRTY SCHEMATIC



2-4.2 Combining Corrosion Control Functions.

Combining functions within the family of corrosion control tasks may only be considered as follows:

- Paint facilities may include both paint and chemical depaint functions with special care taken to address the industrial waste issues of chemical de-paint operations.
- All CCFs and DFs should have a wash function inside the hangar as described in this document as well as paint spray and/or chemical depaint capability (exception: dry depaint facilities will not have a wash function within the hangar bay, but will coordinate with near or adjacent wash racks).
- Performing Paint or Chemical De-paint functions in a facility where Dry Media Blast stripping operations take place is not allowed due to the critical nature of maintaining a dry environment for the Dry Media and the de-paint equipment. Dry Media Stripping and Painting/Chemical De-paint must always be accomplished in separate areas. If grinding operations (scuff sanding) are performed in a Paint Facility, vacuum pickup equipment must be utilized to minimize the spread of dust in the hangar bay. Every effort must be made to maintain a dust free environment where painting is performed.

2-5 FACILITY STUDY.

Due to the complexity and unique characteristics of Aircraft Corrosion Control & Paint Facilities, a facility study must be performed on all proposed CCF and DF projects to determine space and process system requirements.

2-5.1 Space Criteria.

ACCPF space needs are site and mission specific and must be individually programmed based on a facility study. Space program development guidance is provided in UFC 3-260-01, *Airfield and Heliport Planning and Design* and the following documents:

- Army TM 5-803-5, *Installation Design*
- Navy UFC 2-000-05N (P-80), *Facility Planning Criteria for Navy and Marine Corps Shore Installations*.
- Air Force AFH 32-1084, *Facility Requirements*
- *Department of Defense Unified Facilities Criteria UFC 3-101-01, Architecture*

Certain spaces are not defined specifically in space programming criteria. These spaces include air recirculation rooms, fan rooms, and filter plenums for example. These spaces should be considered and added to the space criteria if anticipated.

2-5.2 Facility Space Criteria Study.

Prepare a facility study with input from Chapter 1, Program Authorities, and Chapter 1, Facility Project Team. Also see Appendix B Section 2.2 for design guidance on programming an accurate estimate of the gross area for a new ACCPF. Ensure that the clearance factors in 2-5.3 are addressed in the facility space study to accurately determine the total square footage for the new facility.

2-5.3 Minimum Clearances and Working Space.

For minimum safety clearances based on aircraft type, reference the following documents:

- Army & Air Force: UFC 3-260-01, *Airfield and Heliport Planning and Design*
- Navy: UFC 2-000-05N, (P-80), *Facility Planning Criteria for Navy and Marine Corps Shore Installations*

The size of the various aircraft scheduled to use the facility will determine the hangar bay dimensions. Determine the interior dimensions of the Corrosion Control facility, by using the dimensions of the largest aircraft that will occupy the facility, and adding the minimum clearances indicated below. Include additional space as required for tow vehicles and turning radii. Size the bay to accommodate fixed-wing aircraft with wings unfolded, and helicopters and V-22 with rotors in place and unfolded unless it has been determined that aircraft surfaces are accessible with the wings/rotors folded. Verify the configuration of rotors on rotary aircraft undergoing corrosion control when sizing the process (hangar) bay.

The following minimum operational clearances are required to allow proper access for work platforms and to minimize paint overspray on hangar walls and ceilings:

- Top of aircraft (vertical fin, radome, rotor head, tail rotor) to underside of ceiling - 10 ft (3.0 m); For hangar bays required to have draft curtains, clearance must be to lowest point of draft curtains.
- Nose of aircraft to hangar door - 10 ft (3.0 m);
- Tail of aircraft or tail rotor to exhaust target wall - 10 ft (3.0 m); and
- Horizontal and vertical clearance from aircraft to inside face of open front door - 5 ft (1.5 m). In addition to these clearances, an approximate thickness of the supply and exhaust plenum (T) is required to properly size the gross area of the hangar bay. The equation T = 1/5H defines this approximate depth where H is the height of the aircraft at its highest point plus 5 ft (1.5 m). Note that the depth (T) does not include the thickness of the structure of the door or the filter media. The actual plenum thicknesses are dependent on the airflow required to ensure laminar flow in the hangar and as appropriate for the corrosion control and painting activities.

- Additional clearance between the work platforms and the hangar walls should be considered with respect to circulation space around the aircraft and avoiding pinch points, particularly at the wing tips. Consider tug and cart travel including turning radiuses in developing the required circulation clearances.

Base the number of hangar bays for each site on an analysis of aircraft types, production schedules, hours required for each corrosion control operation, and number of work shifts. Moveable partitions to subdivide the bay are discouraged, as they introduce complications to exiting, fire protection, air flow and balance. Separate spaces where painting is being done from bays in which dry stripping, blasting, or grinding are done.

2-5.4 Ancillary Spaces.

Provide the following Ancillary spaces as a minimum for the Facility

- Ancillary space requirements will vary based on facility requirements. Provide spaces for paint mixing, paint storage, waste paint area, bead blast rooms, gear equipment and tools, office, nondestructive inspection, strip/rinse, paint spray, and dry storage. Base the size of the rooms on the workload. Provide exit doors to the outside for rooms designated for storing or mixing chemicals or paints. Provide a depressed floor slab or doorsills with ramps to contain spills. Separate spaces where sanding, blasting, or grinding are done from spaces where painting is done.
- Provide storage space for dry filters. Provide stairs for personnel and a jib crane for materials transport to the roof or upper floors.
- Provide a loading dock with a manual dock leveler.
- Provide space for work on composite parts including helicopter rotor blades if applicable.
- Locate utilities on the side walls. Use of utility pits in hangar floors is prohibited.
- Decontamination Facilities (See Figure 2-5 for a schematic showing separation of clean and dirty areas):
- For operations where employees may be exposed to harmful contaminants, provide the following:

a. An Initial Decontamination Area inside, or adjacent to the hangar bay. Provide HEPA vacuum for removing accumulations of contaminants from PPE. When located in the Hangar Bay, this area must be on the “clean side”, i.e. close to the supply air side and away from the exhaust air side.

b. A walk-through vestibule with air shower (Air Lock) to capture contaminants between the Initial Decontamination Area and the Initial Accumulation Point.

c. An Initial Accumulation Point with space for drums for disposable PPE.

d. Provide an area with a sink for cleaning, drying and storing respirators.

e. Shower facilities with hot and cold water.

f. Change rooms with separate lockers for protective clothing and street clothes.

g. Toilet facilities must be located on the clean side of the locker rooms.

- Paint Mixing Rooms:

  All dispensing or transfer of flammable liquids from containers, mixing of flammable liquids, and filling of containers, including paint guns and pressure pots must be done only in an approved spray booth or mixing room. A separate paint mixing room will significantly reduce the amount of clutter in the paint booth. A properly designed and located paint mixing room must accommodate all equipment, cabinets, and tables associated with paint mixing and daily-use storage of paints and thinners, which otherwise, would be housed within the confines of the paint booth. Installing prefabricated mixing booth is a simple method to incorporate a separate mixing area into a new or existing facility.

  The design requirements in Chapter 3 are generally applicable to Paint Mixing Rooms. Additional requirements are listed below:

a. The size of the mixing room must not exceed 150 ft2 (14 m2).

b. Must have continuous mechanical ventilation as specified in NFPA 30.

c. Mixing rooms should be provided with a floor drain to make it possible to wash down spills. However, local installations must ensure that collection sumps are installed in the floor drain system and (or) that the wastewater treatment plant can process the spillage. If this is not the case, local installations must develop an alternate means of cleaning up the spillage.

d. Agitators must be driven by compressed air, water, low-pressure steam, or electricity. If powered by an electric motor agitator must meet all electrical codes and standards.

e. An EyeWash/Safety Shower must be located inside or adjacent to a Paint Mixing Room.

- Flammable and Combustible Liquid Storage

  Storage of flammable or combustible storage, in cabinets, specially designed room within the facility or in a detached structure is required.

  Design must comply with UFC 3-600-01, NFPA 80, and 29 CFR 1910.106. AFOSHSTD 91-17 also applies for Air Force Projects.

2-6 HEALTH, SAFETY AND THE ENVIRONMENT.

Planning activities for an ACCPF must address all requirements for worker health and safety, and environmental permitting. Compliance with all health, safety, and environmental regulations is required and is achievable without significantly disrupting the operations if adequate advanced planning and coordination is performed. These issues must be incorporated into the selection of HVAC Systems per this Chapter and Chapter 3. Appendix C provides an overview of the applicable environmental standards.

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CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 GENERAL.

UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, sustainability, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

3-2 ARCHITECTURE.

3-2.1 Exterior Design.

3-2.1.1 Specular Reflectance.

To prevent mirror-like reflections from building surfaces to aircraft in flight, roofs and other external surfaces must have a specular reflectance compatible with the location of the building on the airfield.

3-2.1.2 Operational Hazard Glare.

If the building is located so that glare may be an operational hazard, the critical surfaces of the building must have a light reflectance of not more than 10, measured at an angle of 85 degrees in accordance with ASTM D523, *Standard Test Method for Specular Gloss*.

3-2.1.3 Roof.

The roof must be a smooth surface type or metal standing seam system. Exposed fastener (“Screw Down”) metal roofs must not be specified. If a membrane roof is chosen, gravel or any other material which could become loose and carried off the roof in high winds will not be permitted. The membrane must be specified as being capable of flexing in both directions independent of the roof structure.

Provide exterior access to the high roof the through a secured access panel or hatch, to prohibit unauthorized passage.

Roofs must slope only to the rear or sides of the hangar and not towards the flightline.

3-2.1.4 Exterior Walls.

Exterior walls must be impact resistant material coated with a weather resistant baked on PVDF finish or similar product.

Provide seals at doors, wall penetrations, and building joints in the hangar bays and ancillary spaces to ensure airtight performance to maintain pressure differentials and prevent contamination of the air in the hangar bay.

3-2.1.5 Doors.

3-2.1.5.1 Hangar Doors.

Hangar doors defined in this section are a specialized, insulated, hangar Supply Air type with swinging or sliding leaves. These doors are designed to serve as insulated supply air plenums when closed. Eighteen (18) gauge galvanized steel perforated plates are to be placed on the inside face of in the supply air plenums with a means to allow for balancing air of distribution to achieve evenly distributed laminar flow in the hangar bay. The hangar door acts as a plenum, thus see Section 3-5.2.8 Ventilation System Configurations for additional design criteria to construct Supply and Exhaust Plenums for horizontal laminar air flow. Other arrangements may be used if the required calculations are performed or if alternative successful designs can be proven. A Computational Fluid Dynamics study is required or other means of verification of the air delivery method if the proposed system is unproven.

The hangar doors must be electric motor operated. Each leaf must operate independently from its' own drive unit. Each drive unit must have a release mechanism, and the doors must be provided with a means of mechanical attachment for movement in the event of power failure. The minimum speed of door travel must be 60 feet (18.29 meters) per minute. Thresholds must be designed to minimize dirt accumulation and ice buildup.

Control of the doors must be by momentary contact type push buttons located near the leading edge on both sides of the door with limit switches on each door leaf to stop door movement. Safety devices must be installed to prevent injury to personnel and damage to equipment by moving door sections. If personnel access doors are provided in the hangar door leaves, an interlock must be installed at each access door to prevent operation of the hangar door leaves when the personnel access doors are open and halt the hangar door leaves in the event a personnel access door is opened while the hangar door leaves are in operation. An alarm must sound in conjunction with safety warning beacons when doors are in motion. Sliding steel hangar doors must be in accordance with UFGS 08 34 16, *Corrosion Control Hangar Doors*.

Configure horizontal sliding hangar doors such that they are operable during power outages, by both manual and electrical means (electrical means via emergency power).

3-2.1.5.2 Other Doors.

No hold-open devices are permitted. Take special precautions to seal doors between hangar areas and exterior or adjacent spaces.

Exterior doors with closers must be Level 4, physical performance Level A doors complying with ANSI/SDI A250.8. Frames must match door level. Exterior door frames must be welded type.

Provide Grade 1 hardware typical. Locksets must be mortise type, Series 1000 as defined by ANSI/BHMA A156.13. Hinges for all doors must be rated for heavy-duty. Closers must be the best and highest grade available from each manufacturer. Exterior doors must have overhead rain drips and door drips.

3-2.2 Interior Design.

3-2.2.1 Interior Walls.

See UFC 1-200-01, NFPA 101 and the IBC for general area separation requirements for interior walls. For Army and Navy projects, separate hangar bays in multiple-bay structures by 3-hour fire-rated walls. For Air Force projects, see ETL 02-15 for separation requirements.

Provide wall penetrations and building joints in the hangar bays and ancillary spaces to ensure airtight performance to maintain pressure differentials and prevent contamination of the air in the hangar bay.

The hangar bay must be provided with durable finishes. The exterior walls must have as a minimum, a protective panel along the exterior walls that will prevent damage to the exterior finish system. Generally, a hangar bay will be comprised of metal wall panels and protection must be provided from the interior of the hangar bay. The minimum protection can be provided by a non-insulated metal panel attached to the wall panel girts. The protective panel must extend to at least 7 feet (2.13 meters) above the hangar floor. Alternatively, a masonry panel may be provided.

All unfinished items must be painted. A wall base is not required in the hangar bay.

Partitions must extend to the floor or roof construction above unless allowed in the following sections.

Walls must be painted concrete masonry units or concrete around shop spaces. For shops without ceilings, partitions must extend to floor construction above.

Partitions separating administrative spaces may be gypsum board construction. Partitions may extend to above the ceiling for similar office types and spaces where noise between offices is not an acoustical issue. Extend walls to ceiling adjacent to noise-producing areas. Paint all unfinished materials.

Provide Concrete Masonry Unit (CMU) partitions around toilet and locker rooms. Partitions around perimeter of space must extend to floor or roof construction above. Provide ceramic tile wainscot and ceramic base. Provide ceramic tile wall finishes to the ceiling on all walls in showers.

3-2.2.2 Surface Treatment.

Provide the sidewalls, the inside of hangar doors, and the ceiling of the hangar area with a light color, smooth surface such as white enameled metal panels.

3-2.2.3 Floors.

Floors must meet the following criteria:

- The hangar area floor must be designed in accordance with criteria in UFC 3-260-02, *Pavement Design for Airfields*.
- Design other floors in accordance with UFC 1-200-01. Install resilient tile or sheet floor coverings.
- For new construction, provide a white dry shake floor hardener as the topping on the floor slab in the hangar area. Use of a thin epoxy white reflective floor coating is not recommended

3-2.2.4 Ceilings

Aircraft bays and paint storage, mixing, and spray areas must have water-resistant gypsum ceilings or a metal panel ceiling system. Provide a 1-hour fire-rated ceiling in paint bays. Consideration should be given to utilization of the ceiling deck above the hangar bay as a walking surface for access to the overhead light fixtures and also mechanical and electrical distribution systems generally located in the ceiling space above the hangar bay.

Provide suspended acoustical ceilings for corridors, toilets, locker rooms, and offices. Install suspended acoustical ceiling panels with vinyl plastic surfaces in shower areas.

3-2.3 Acoustics.

Develop a comprehensive acoustical design for the facility as required by UFC 3-101-01. Design the facility to provide a comfortable acoustical environment that limits exterior and interior noise intrusion to sensitive spaces.

Due to the industrial nature of a Corrosion Control Facility, an Acoustical Study must be performed on all occupied spaces during the design phase of each project. This study will entail assigning ambient noise levels to every occupied space, identifying all sound generating equipment and sources, then determining the method of sound isolation or reduction required to meet the required ambient noise levels.

Once the project construction is complete and all noise generating sources are operational, a sound level check must be performed to verify that predicted ambient noise levels have been met. Spaces not meeting the sound design levels will require additional acoustical treatment to bring all areas into compliance.

3-3 CONVEYING SYSTEMS.

3-3.1 Weight Handling Equipment.

Weight Handling Equipment must be of spark-proof construction with an explosion-proof motor. Controls must be operable from the floor level and, when electric, must meet the requirements indicated in Chapter 3, Electrical.

3-4 PLUMBING.

3-4.1 Water and Sewer

Provide plumbing in accordance with UFC 3-420-01 and as follows:

- Provide one shower for every ten (10) employees (or fraction thereof) of each sex who are required to shower during the same shift. Each rest room must have direct access to appropriate lockers and showers.
- Emergency eyewash/safety showers where required must conform to Appendix D of UFC 3-420-01.
- Floor Drains in the hangar area, paint mixing rooms and paint equipment cleaning rooms must be connected to the Industrial Waste system or piped to an isolated holding pit for testing to determine proper disposal of effluent
- Locate storm-water drains at least 12 in (310 mm) from the hangar access door rails.

3-4.2 Industrial Waste.

Provide a connection to an Industrial Waste Treatment System or to a collection containment tank or pit from all drains in process areas.

Provide for zero discharge from the facility unless the facility will discharge to an existing or new industrial waste treatment facility (IWTF) or to a municipal sewer system. The IWTF must be capable of handling both the type and volume of the chemicals that will be discharged. Disposal into a municipal sewer system requires a minimum pretreatment in compliance with 40 CFR Part 403, or AFI 32-7041.

3-4.3 Control of Hazardous Effluents.

Provide AFFF/Sprinkler discharge collection/retention system when required by environmental regulations for testing and pre-treatment prior to discharge into the appropriate waste stream. For design of containment systems and disposal requirements for AFFF solution, refer to ETL 1110-3-481, *Containment and Disposal of Aqueous Film-Forming Foam Solution*.

The corrosion control process generates large amounts of water that could potentially hold solid or liquid paint residue or other solvents and wastes. If the local wastewater treatment plant cannot accept the effluent generated from the facility, on-site treatment or containment and off-site disposal is required. Refer to UFC 4-451-10N, *Design: Hazardous Waste Storage*, and UFC 4-832-01N, *Design: Industrial and Oily Wastewater Control*. Design for accidental spill of paint strippers and thinners, paint, cleaning solvents, pretreatment chemicals, fuel or oil. Provide above-grade containment of accidental spills with appropriate sumps for pumping and cleanup of spilled wastes. Size the containment capacity for the largest possible discharge. Provide a method to prevent the drains from clogging.

3-4.4 Compressed Air.

Provide low-pressure air for operation of tools and for breathing air in accordance with the following criteria:

- Provide low-pressure compressed air at 40 percent to 60 percent humidity and at 125 psig (862 kPa) for shop use. Air should be oil-free to prevent paint contamination. Air outlets supplying tools requiring lubrication should be equipped with an in-line lubricator. Rotary oil-free compressors are recommended since this compressed air may be used as a source for breathing air at lower life cycle costs.
- Provide low-pressure compressed air at 20 psig (138 kPa) or higher if required, at 40 percent to 60 percent humidity for breathing air in the hangar bays. The breathing air compressor must minimize moisture content so that the dew point is 10 degrees Fahrenheit (5.56 degrees Celsius) below the ambient temperature. Breathing air must be obtained from the oil-free shop air source through final purifiers in each bay or from a separate breathing air compressor and piping system that meets requirements by OSHA for minimum Grade D air as described in ANSI/CGA G-7.1 Commodity Specification for Air. Breathing air from the oil-free shop air source is preferred because of lower cost.
- The air outlets (quick connect fittings) for oil-free shop air, lubricated tool air, and breathing air must be different for each service and must not be compatible with each other.
- Typical outlet quantities for each bay are: four breathing and four oil-free shop air and two lubricated tool air. Typically, two oil-free shop air outlets are required per ancillary space. Verify actual requirements for each site.
- Locate the intake for breathing air in an uncontaminated area. Air-line respirators approved with a vortex tube will substantially reduce the temperature of the air supplied to the respirator in cases where the supplied air is from a high temperature environment

3-4.5 Process Systems.

The chemicals used in the aircraft corrosion control process can be hazardous to workers, corrosive to the facility infrastructure, and require considerable floor space to store, access, and distribute. The Using Activity must provide a complete list of all chemicals used in the process with relevant MSDS’s to the design team during the planning and design phases to insure that the facility can control the hazards appropriately. The data sheets will also be utilized in the design of the process systems to select compatible materials to contain and distribute the process chemicals used in the aircraft preparation and painting.

3-5 HEATING, VENTILATING & AIR CONDITIONING (HVAC)

General requirements for HVAC design are identified in UFC 1-200-01. Additional design guidelines for LonWorks® based control systems include UFC 3-470-01, *Lonworks (R) Utility Monitoring and Control System (UMCS)*, and UFC 3-410-02, *Lonworks (R) Direct Digital Control for HVAC and Other Local Building Systems.*

3-5.1 Hangar Bay HVAC Process Requirements.

A. The required hangar bay design heating temperature will normally be between 70 degrees F (24 degrees C) and 90 degrees F (32 degrees C) with a relative humidity between 50 and 70 percent. Some activities may require higher temperatures to accelerate curing cycles. Process temperature & humidity requirements for the CCF Hangar Bay will be the more stringent of either the following:

- environmental requirements from the coating material manufacturer
- personnel heat stress criteria requirements per USACE document EM 385-1-1, *Safety and Health Requirements Manual*, OPNAV Instruction 5100.23G *Navy Safety & Occupational Health (SOH) Program Manual* (specific ref. to Heat Safety) and AETC Instruction 48-101, *Prevention of Heat Stress Disorders*

a. Provide a snow-melting system at the hangar door tracks when the outside design temperature is +25 degrees F (-4 degrees C) or lower and when historical snow data supports the requirement.

b. Heating must be suitable for operation in the vapor hazard condition in the hangar bay, flammable storage/mixing areas and paint equipment cleaning spaces.

c. Refer to the Functional Data Sheets for design conditions in the ancillary spaces.

d. Provide a means to meter separately the ancillary HVAC loads from the Process Ventilation loads.

e. The design of a Depot Level facility must include equipment redundancy relative to the projected aircraft throughput for all systems where a critical component failure would render the facility's mission non-operational and repair or replacement timing would delay the schedule objective.

3-5.2 Ventilation for Control of Air Contaminants and Flammable Vapors

3-5.2.1 Ventilation – General.

The objective of the process ventilation design is to provide a system that is safe, energy efficient and cost effective (installation and maintenance) and environmentally compliant while maintaining the primary goal of ensuring operator health and safety at all times.

NOTE: All facilities must be designed to the requirements of 29 CFR 1910.94 *Ventilation*, 29 CFR 1910.106, *Flammable and Combustible Liquids*, and 29 CFR

1910.107, *Spray Finishing Using Flammable and Combustible Materials* as well as NFPA 33 and Subpart Z of 29 CFR 1910.

3-5.2.2 Paint Spray Systems.

The use of High Volume Low Pressure (HVLP) and HVLP electrostatic paint application techniques greatly reduces the amount of overspray exposure to workers, versus conventional air atomization or air-assisted airless. The reduced overspray increases exhaust filter life. The use of electrostatic paint systems also reduces the airflow requirements (per 29 CFR 1910.107) and related fan size and horsepower. When working *inside* the aircraft, portable supply and exhaust ventilation systems may be needed to control occupational exposures in the enclosed space.

3-5.2.3 Supply Air Requirements.

Provide ventilation in accordance with NFPA 33 and ANSI/AIHA Z9.2, AIHA Z9.4, and ANSI/AIHA Z9.7; refer to Appendix B for further guidance. For conventional air atomization paint spray systems operating within a "Paint Booth", the supply air system must furnish 100 percent filtered outside air at a horizontal laminar flow velocity of 100 fpm (0.508 m/s) across the entire cross section area of the hangar bay for worker safety and overspray control in accordance with OSHA.

Due to the large volume within aircraft hangars relative to the actual quantity of spray paint being applied, the designer may now define the paint operation envelope as a Paint Area instead of a Paint Booth. The Paint Area interpretation of aircraft paint operations is concerned with the envelop within and immediately surrounding the paint sprayers (29 CFR 1910.107 (a)(2)). The volume of outside air and the velocity of the airflow may be decreased from that required for an entire hangar bay under the conventional interpretation as a Paint Booth in accordance with OSHA and its interpretations for consideration of Paint Spray Areas vs. Paint Booths. The reduction of the airflow cross sectional area must be reviewed with the local Industrial Hygienist and Safety entities and verified with an airflow study as part of the design process. Ultimate interpretation and acceptance of a paint spray envelop designation as a Paint Area will come from the local Industrial Hygienist, Safety entities and the other "Authorities Having Jurisdiction".

OSHA also allows for a reduction in airflow velocity for paint spray systems which improve capture and reduce overspray. The minimum maintained air velocity required for hand held electrostatic paint spray operations as specified in 29 CFR 1910.107 (b)(5)(i) is 60 linear fpm. However, the requirements currently contained in 29 CFR 1910.94 (c)(6)(i) Table G-10 are somewhat more lenient and allows a range of 50-75 linear fpm. Due to the minor variations in these requirements, any Design Team planning a paint facility that will be used exclusively for electrostatic paint spraying must contact their local fire protection and bio-environmental engineering functions for guidance on current local OSHA interpretations.

Additional considerations for reducing the air volume requirements through a hangar bay during paint spray operations are as follows:

- Minimize the open cross sectional area in the hangar bay during the design of the hangar structure to reduce the total quantity of airflow while maintaining a safe, efficient working environment.
- Airflow recirculation may also be investigated as a means to reduce energy usage while still maintaining worker safety. See Section 3-5.2.7 Consideration of Airflow Recirculation and Section 2-3 HVAC System Planning & Selection.
- NOTE: Recirculation of exhaust air or reduced air flow during painting may result in a DeMinimus violation from OSHA. See Appendix D, Fig. D-2 – OSHA Interpretation regarding the DeMinimus violation.

Ventilation and airflow requirements for chemical de-paint operations are dependent upon the makeup and toxicity of the material being applied to the aircraft for paint removal. The de-paint material manufacturer must be consulted to obtain the applicable MSDSs for the determination of the appropriate ventilation rate.

Filtration must be provided for the Supply Air upstream of the supply fans and in the supply plenum doors. The filters must have a MERV 5 or better rating on the basis of ASHRAE 52.2 *Method of Testing General Ventilation Air-Cleaning Devices Used for the Removal Efficiency by Particle Size.*

Note: MERV or Minimum Efficiency Reporting Value, is a measurement of air filter efficiency established by ASHRAE. The MERV number ranges from 1 to 16; the higher the MERV number, the higher the efficiency of the air filter at removing particulate matter.

3-5.2.4 Space Static Pressure Controls.

The ventilation system must maintain a slightly negative static pressure of -0.02 to -0.04 in. water gage between the hangar area and the exterior to prevent fugitive hazardous emissions from escaping the hangar envelope and entering the atmosphere. Some studies indicate that a slightly negative pressure in the painting area also provides for more superior painting and reduces turbulent flow. (Refer to *System-Level Computational Fluid Dynamics: Advanced CFD Tools to Solve Problems of Operational Conditions, States of Large-Scale Engineered and Natural Systems* for additional guidance.) Maintain a slightly higher pressure in the adjacent ancillary and overhead ceiling spaces outside the hangar area to keep the hazardous vapors given off by painting agents from infiltrating into these spaces. Ventilate the space above the hangar bay ceiling to provide a non-hazardous space for light fixtures.

3-5.2.5 Gauges, Safety Interlocks and Alarms.

Install visual gauges, audible alarms, and/or pressure activated devices on filters to ensure that the minimum air velocity or volume is maintained. Interlock the fans and the process air compressors so that the paint spray air compressors cannot operate when the fans are inoperative or below a preset minimum. Breathing air must **never** have an interlocked shut down. Interlock the fans and the fire protection system so that the fans cannot operate when the fire protection system is inoperative. The electrical equipment used in the electrostatic spraying process must be interlocked with the ventilation spraying area so that the equipment cannot be operated unless the ventilation fans are in operation. The operation can be verified by a total air volume flow monitor through the hangar bay. Air flow volume, space static pressure, fan status, breathing air system, and other critical component failures must be monitored by the building automated control system. All critical alarms, notifications and status points must also be indicated on a control panel either within or adjacent to the hangar at an operator monitoring station. The location of the Critical Component Monitor and Alarm Panel must be incorporated into the emergency/fire response action plan. An audible and visual alarm system, which activates in the event of a ventilation or other critical system failure must be provided and made active during the paint spraying process.

3-5.2.6 Energy Conservation.

Reference UFC 3-400-01, *Energy Conservation.* Include energy conserving designs such as ice storage, heat recovery or air recirculation for the ventilation system serving the hangar bay as part of the initial design development of the overall ACCPF. Heat recovery systems must not permit contaminated exhaust air from migrating into the supply air system.

Exhaust stacks must be the “no loss” type as shown in ACGIH *Industrial Ventilation, a Manual of Recommended Practice*.

See section 2-3, HVAC System Planning and Selection for guidance in the evaluation of a cost effective, energy efficient ventilation system.

3-5.2.7 Consideration of Airflow Recirculation.

The determination of the most energy efficient process ventilation system includes evaluation of alternative methods designed to reduce or optimize energy usage. One method which can potentially reduce energy usage in a ventilation system is recirculation of the ventilation or exhaust air. See Section 2-3 HVAC System Planning & Selection for the evaluation process to determine the most cost effective HVAC process ventilation system for a specific application. If recirculation is determined to be a viable option, see NPFA-33 and ANSI/AIHA Z9.7 and appendix D in this document for the AFRL on Recirculation and OSHA interpretations which allow for reduction in equipment sizing and re-circulated air flow.

3-5.2.8 Ventilation System Configurations.

3-5.2.8.1 Hangar Bay Air Flow Design.

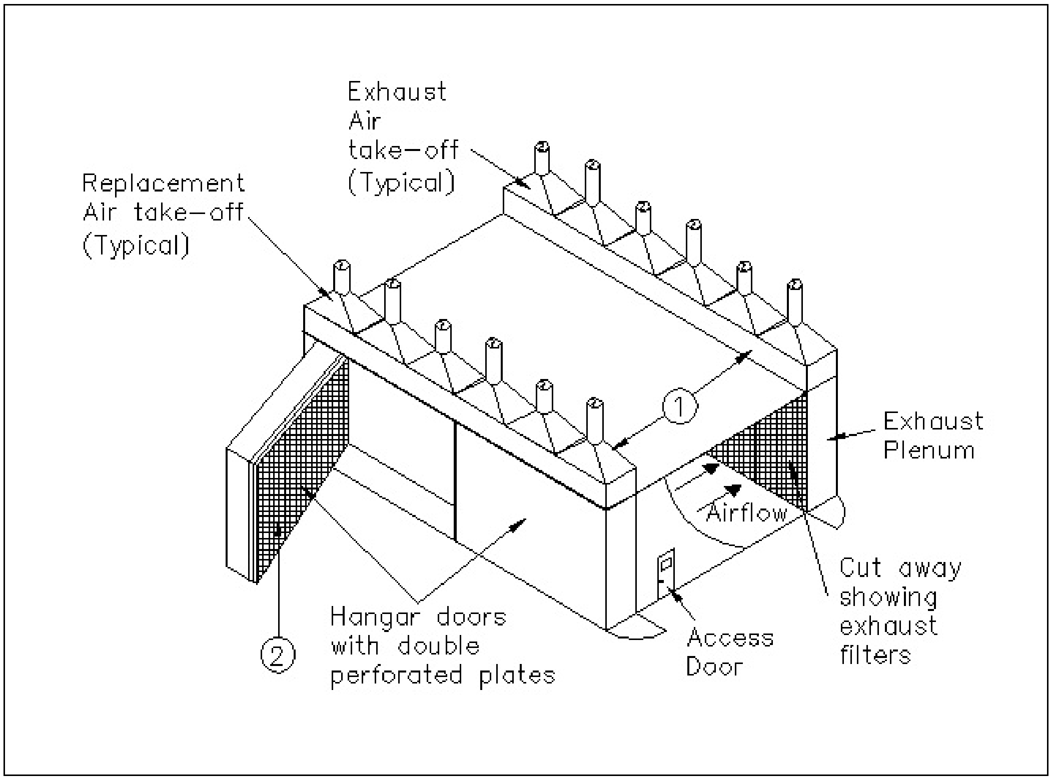
Design or specify the entire supply and exhaust air system using criteria for a horizontal flow hangar configuration with supply air direction from aircraft nose to tail. Figure 3-1 and Figure 3-2 are two methods of designing hangar horizontal airflow distribution. Other configurations must be appropriate for the aircraft mission and approved by the AHJ. Effective capture of the paint overspray and worker safety must be the primary objective in determining the optimum airflow design. All designs for ventilation systems must introduce the makeup air in a laminar manner and minimize the creation of dead air pockets. This will help to capture the paint overspray and reduce the possible buildup of contaminants.

3-5.2.8.2 Hangar Door Plenums.

Air plenums may be incorporated into the design of the hangar doors as indicated in Figure 3-1. This design may be configured as a swing door as shown (most commonly utilized for fighter or similar sized aircraft), or a double rolling door arrangement where two sets of doors form an air plenum between the inner and outer sides. The double door configuration is generally selected for use with cargo or similar sized aircraft.

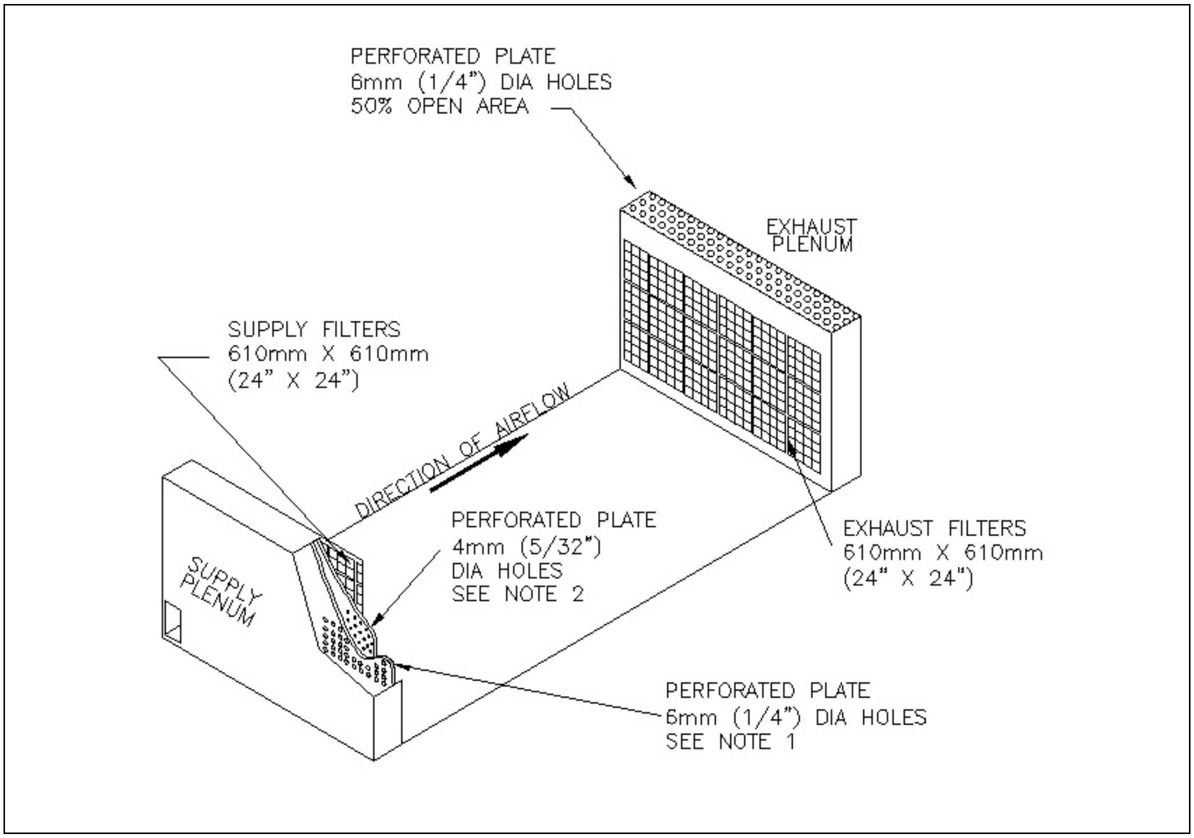
The incorporation of an air plenum into a hangar door requires that the air performance characteristics of the plenum remain primary in the Plenum/Door system. The integrity of the air side of the “Plenum Door” must always be maintained and not compromised in favor of space or door function considerations.

FIGURE 3-1. SAMPLE HORIZONTAL FLOW HANGAR CONFIGURATION



NOTES:
1. Size the exhaust plenum for a maximum plenum velocity of 1,000 fpm (5.08 m/s). Size the supply air plenum for a maximum plenum velocity of 500 fpm (2.54 m/s).
2. See Figure 3-2 for hangar doors and exhaust plenum details.
3. Although supply air is shown entering plenum/door from top, the more common supply air path is through door hinges.

FIGURE 3-2. SUPPLY AND EXHAUST PLENUM AIRFLOW CONTROL DETAILS



NOTES:
1. Size open area for an airflow velocity of 2,000 fpm (10.16 m/s) through holes.
2. Size open area for an airflow velocity of between 600 to 700 fpm (3 to 3.5 m/s) through holes.

3-5.2.9 Control of Air Emissions

3-5.2.9.1 Air Emissions Overview.

Emissions of volatile organic compounds (VOC), hazardous air pollutants (HAP) and particulates from surface coating facilities are regulated by USEPA and state environmental agencies via various air pollution regulations, including the National Emission Standard for Hazardous Air Pollutants (NESHAP) for Aerospace Manufacturing and Rework Facilities (40 CFR 63, Subpart GG). Consult the base environmental office and the cognizant Facilities Engineering Command for appropriate requirements for the site. Make every effort to achieve compliance with applicable regulations considering all available pollution prevention alternatives versus the use of VOC/HAP emission controls. Consider recirculation of airflow per NPFA-33 and ANSI/AIHA Z9.7. See appendix D for additional information for OSHA interpretations and the AFRL. Recirculation allows for pollution abatement sizing equipment reduction.

3-5.2.9.2 Aerospace Exhaust Filter Requirements.

A paint spray ventilation system is required to minimize the amount of hazardous air pollutants (HAPs) that are released into the atmosphere. The National Emission Standard for Hazardous Air Pollutants (NESHAP) for the Source Category: Aerospace Manufacturing and Rework Facilities ,commonly called the Aerospace NESHAP requires that particulate filters be installed in the ventilation system to control the inorganic HAP emissions(e.g., chromium, cadmium, lead for example) before they are exhausted to the atmosphere. Filters throughout must be made from noncombustible materials and must meet approval of the fire protection authorities.

Organic HAPS are Volatile Organic Compounds which cannot be captured by the particulate NESHAP filters used on the inorganic HAPS. The hazardous VOCs (or organic HAPs) include 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, trichloroethylene, and toluene. VOC (solvent vapor) capture methods such as carbon bed filters must be utilized when hazardous VOC removal or control is required. The requirement to control or capture VOCs is a function of state or local regulations, dependent upon the specific location's classification as an "attainment" or "non-attainment" area per the EPA's designation. The local air quality authorities must be consulted in order to determine requirements for VOC abatement.

Determine the specific type of exhaust filter system required by an analysis of the environmental control regulations at the site of the proposed ACCPF.

3-5.3 HVAC for Ancillary Spaces.

3-5.3.1 Operational Ancillary Spaces.

Provide exhaust ventilation from the floor level for the paint mixing and storage rooms. Refer to *ACGIH Industrial Ventilation* (ACGIH IV)*, A Manual of Recommended Practice*. Also, paint mixing can be done on ventilated benches. Refer to UFC 3-410-04, *Industrial Ventilation*. Provide ventilation systems for paint mixing and paint equipment-cleaning rooms in accordance with *NFPA 33* and the *ACGIH IV*.

3-5.3.2 Administrative and Miscellaneous Support Spaces.

The ventilation design of all spaces adjacent to, in close proximity with, or otherwise possibly affected by the paint spray area operation must provide a positive static pressure relative to the paint spray area in order to prevent the migration of paint vapors into the non-spray areas. Measuring devices must be provided to visually identify the static pressure differential between the paint spray and non-paint spray areas.

3-5.4 Noise and Vibration Control.

Design mechanical systems and equipment to limit noise and vibration in accordance with UFC 3-450-01, *Noise and Vibration Control,* and OSHA Pub 3048, *NPC Hearing: Noise Control – A Guide for Workers and Employees*. Navy projects must also follow NAVFAC P-970, *Planning in the Noise Environment*.

Design hangar bay for maximum 75 dBA space average. Provide sound traps to attenuate fan noise down to this level. Noise levels of 55 dBA in the hangar bay area with the ventilation system operating at maximum airflow have been achieved with careful design attention to fan and duct noise characteristics. Outdoor noise levels must not exceed 75 dBA and must comply with local regulations.

3-6 FIRE PROTECTION AND LIFE SAFETY.

Provide fire protection in accordance with UFC 3-600-01, *Fire Protection Engineering for Facilities* and the following documents:

- Army. ETL 1110-3-485, Fire Protection for Helicopter Hangars, and ETL 1110-3-484, Aircraft Hangar Fire Protection Systems.
- Navy. UFC 4-211-01N, *Aircraft Maintenance Hangars: Type I, Type II and Type III.*
- Air Force. ETL 02-15, Fire Protection Criteria - New Aircraft Facilities, and ETL 98-8, Fire Protection Criteria - Existing Aircraft Facilities.
- NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials;
- NFPA 101, Life Safety Code

Note: Foam Fire Protection is not required for hangars housing aircraft that are defueled and purged or have their fuel cells removed. The requirements in NFPA 409 for unfueled aircraft must be followed for these situations.

3-7 ELECTRICAL.

3-7.1 Electrical Installations.

3-7.1.1 General.

Provide electrical systems in accordance with UFC 3-501-01, *Electrical Engineering* and as follows:

3-7.1.2 Power.

All Areas - Provide separate dedicated panel boards to serve each separate use area.

Hangar Bay - Electrical equipment in the hangar bay must be waterproof or water protected when AFFF and/or deluge water protection is provided to prevent equipment damage in the event of testing or accidental discharge of the deluge system.

Power Service Points:

- Service Points for Ground Service Equipment (GSE), Portable Lighting, or other portable support equipment must meet requirements of the hazard classification of the space.

- Air Force only – The 6-pin "WMJ" receptacle may not be permanently installed in a depot paint/depaint or CCF hangar bay. The "WMJ" receptacle may be installed as a temporary GSE power supply only when non-painting activities are taking place. The "WMJ" receptacles must be removed prior to the initiation of paint/depaint operations.
- External aircraft power provided by the power service points must be within the voltage and frequency tolerances specified for aircraft type. The flexible power cable to the aircraft must be adequately sized to meet the specified aircraft loading (amperage) requirements.
- Three phase, 115/200V, 4-wire, 400 Hz, (kVA ratings as required by aircraft type). Refer to UFC 4-121-10N, *Design: Aircraft Fixed Point Utility Systems* for 400 Hz power requirements and to criteria for hangar bay space power and grounding requirements for aircraft maintenance. Spiral wrapped, six around one, flexible cables, designed specifically for 400-hertz systems must be used. The cable must consist of six power conductors, two per phase, helically laid around one central neutral conductor. The conductor size must be based on the KVA rating of the aircraft type. The cable must also contain a minimum of six control conductors, minimum size # 18 AWG.
- 270 VDC Power, and 28 VDC (interlock power), ratings as required by aircraft type. The 270 VDC power cables must be low inductance, low impedance in order to minimize cross-coupling. The 270 VDC cables must also contain 28 VDC safety interlock wiring. The conductor size must be based on the KVA rating of the aircraft type.
- 28 V direct current (kVA ratings as required by aircraft type) Coordinate with the activity.
- WARNING: Aircraft external power supplies are not rated for the hazard classification of a Paint Spray Bay (Class 1, Division 1). Therefore, all activities requiring the use of external power must be completed, the power cord disconnected from the aircraft and the power to the cord disconnected outside the hangar bay prior to the commencement of spray paint operations.

<u>Emergency Power</u>.-Emergency power must be provided to ensure safe egress from any point within the facility. Emergency power must also serve any component that is required for safe egress from any location on an aircraft in the hangar bay. Availability of breathing air must be included in the emergency egress considerations. Hangar doors must also be operable via emergency power. Coordinate and provide additional emergency power as dictated by the mission. A distinct audible and visual alarm must be initiated whenever the facility experiences a loss of main power

<u>Ancillary Spaces</u>. - Serve shop spaces by distinct panels dedicated to shop and equipment loads only. Do not supply office spaces from shop circuits or panels. Except as specifically noted otherwise, feed loads located in the Shop space from panel boards

located in the Shop space; feed loads located in the Office space from panel boards located in the Office space.

3-7.2 Electrical Hazardous Classifications.

Electrical installations in the following areas must meet the requirements in NFPA 70, *National Electrical Code* for the specific hazardous (classified) location:

- Hangar area,
- Paint and chemical mixing rooms,
- Paint equipment cleaning room,
- Paint storage room.

3-7.3 Grounding.

Provide grounding in accordance with UFC 3-575-01, *Lightning and Static Electricity Protection Systems.*

3-7.4 Lighting.

Provide lighting in accordance with UFC 3-530-01, *Design: Interior and Exterior Lighting and Controls*, and as described below:

- Avoid the use of explosion-proof overhead fixtures by providing sealed, ventilated space above the finished ceiling. Fixtures may then be installed above the classified space.
- Hangar Lighting level – Interior lighting level of 100 FC measured 30 inches from floor must be available for Painting Operations inside the hangar bay. A lesser lighting level may be provided during non-critical operations to be determined by the Operating Group.
- Controllable Hangar Bay Lighting - min. 50 FC up to 100 FC in hangar bay. Provide to the best extent possible a lighting arrangement and control which allows for staged control of fixtures which can provide 50 FC, 75 FC and 100 FC progressively to the hangar floor.
- Vertical aircraft surfaces must be considered and incorporated into the hangar interior lighting design. This lighting may be permanently installed in the side walls, on man lift platforms (if provided), or as portable units. A minimum of 70 FC must be used as the design lighting level for vertical surfaces. Note: Hazard classification must be maintained in all cases.

3-8 EQUIPMENT

3-8.1 Work Platforms.

3-8.1.1 Floor Supported Platforms (FSPs).

Floor supported platforms offer an economical means of accessing elevated aircraft surfaces. Typical FSPs include under wing service decks, vertical scissor lifts, rolling step platforms and telescoping boom lifts. This type of equipment is generally purchased separately from the facility construction budget and not included as part of real property. Consideration of this equipment during the planning phase, however, is essential to ensure sufficient clearance around the aircraft when the lifts are in place, and housing the lifts when not in use.

3-8.1.2 Overhead Telescoping Manlift Platforms (TMPs).

The overhead man-aboard TMPs offer a great deal of flexibility and efficiency of operation for an ACCPF. The TMPs are generally considered when large vertical surfaces such as Vertical Stabilizers or Rudders on large aircraft require access for painting, depainting or repair. The platforms themselves can be designed to carry a painter (or two), his equipment and a technician/spotter (driver).The TMPs become essential for a Depot Facility when timing is critical due to the required aircraft throughput. For a CCF, TMPs offer quick access to virtually any part of an aircraft needing repair or corrosion attention when immediate response is called for in the stated mission. TMPs also provide the advantage of offering access to a variety of aircraft.

TMPs impart a significant load on the structure of the facility and ultimately to the foundations. Therefore, inclusion or exclusion of TMPS must be established early in the planning phase.

As a practical solution, a combination of FSPs and TMPs are generally selected to most efficiently cover an aircraft for a specific corrosion control operation. A full definition and understanding of the mission of the facility is essential in forming the basis for the selection of these systems.

3-8.2 Fall Protection.

Personnel fall protection is required when work platforms are not adequate or practical to reach the upper surfaces of the aircraft or when personnel must walk on aircraft wings or other surfaces during corrosion operations.

3-8.2.1 Personal Fall Arrest System (PFAS).

The PFAS consists of a full body harness, attached to a vertical life line cable or self retracting device which is then connected to a horizontal lifeline (HLL) installed below the ceiling/roof structure.

The PFAS must comply with ANSI/ASSE Z359 Fall Protection Code/Product Standards and 29 CFR 1910. For Navy projects also see UFC 4-211-01N. For Air Force Projects, see AFOSHSTD 91-100, EM 385-1-1 Section 21, and AFOSHSTD 91-501.

3-8.2.2 Flexible Horizontal Lifeline (HLL) Systems.

The HLL system must be constructed of flexible material such as wire rope, fiber or webbing spanned horizontally between two end anchorages and may have intermediate anchorages (singe lor multi span), in-line energy absorber, life line tensioner and turn buckles. HLL system shall be designed and certified by a professional engineer who is qualified in designing HLL systems. The designer must consider the number or workers attached to the system, the sag of the line, clearance requirements and the strength of the end and intermediate anchorages. The design, layout and performance of the flexible HLL shall be traceable to test results and engineering calculations. Calculations that predict the performance of the system shall be validated by tests performed on the system in accordance with the requirements of the ANSI/ASSE Z359 Fall Protection Code/Standards.

3-8.3 Rigid Rail Lifeline Systems

The horizontal rigid rail system (trolly system) shall be constructed of rigid steel track(s), mounted hangers, end stops bumpers, splices and swivel eye trolly. The planner must consider the number or workers attached to the system.

3-8.3.1 Facility design for PFAS.

The most significant fall protection requirement from a facility design perspective is the large load capacity which must be built into the permanent lifeline anchor points attached to the building structure.

Design of anchorages for fall protection is addressed in UFC 3-301-01, *Structural Engineering*. It is imperative that the fall protection system be incorporated early in the planning stage of the facility to allow these loads to be realized and included in the structural design.

3-8.3.2 PFAS Installation.

A Turnkey “furnish & install” PFAS/HLL system by an experienced fall arrest specialist is recommended for best assurance of an ANSI and OSHA compliant system. The manufacturer or installer must provide calculations and drawings to verify that the system meets the design and operational requirements. The manufacturer/installer must also be responsible for testing and certifying the system, providing all verification documentation and training the facility personnel as a requirement for Government acceptance.

3-8.3.3 PFAS and Overhead Crane Coordination.

Hangars with bridge cranes represent a special challenge to the planner/designer in that the Overhead Cranes and PFAS often compete for the same space and the workers attached to their PFAS are at risk of having their life lines struck by the moving crane if both operations happen simultaneously. The first recommendation is to design the two systems so that there is never an overlap or interference. If this is not possible, then it must be mandatory that the two operations can never occur at the same time. If personnel are within a crane runway area, the cranes must be locked out. Likewise, if the Overhead Cranes are to be operated, the PFAS must be physically relocated out of the path of the crane. It is important for the designers of aircraft hangars to understand the potential conflicts between the two systems and the means by which they can coexist.

3-8.4 Blast and Paint Booths.

See UFC 3-410-04, *Industrial Ventilation*, for Modular “Stand Alone” Paint Spray Booths and Dry Media Blast (DMB) De-paint enclosures. All utilities for the booths must be included in the planning phase of the primary facility. If the booth is to be installed in an interior space, provide sufficient space around the booth to allow for access to maintenance and cleaning.

3-9 SITE WORK.

3-9.1 Aircraft Pavement Design.

Aircraft pavement must be in accordance with UFC 3-260-02.

3-9.2 Site Lighting.

Orient exterior fixtures to minimize glare on ramps and taxi-ways. Refer to UFC 3-260-01, *Airfield and Heliport Planning and Design* for clearance requirements, obstruction lighting requirements, and airfield utility lighting information.

3-10 HEALTH SAFETY AND ENVIRONMENTAL CONTROLS.

3-10.1 Health and Safety

The following Health and Safety standards must be incorporated into the design of all Corrosion Control and Paint Finishing Facilities:

- 29 CFR 1910 Subpart D – *Walking-Working Surfaces*, Sections 1910.21 thru 1910.27
- 29 CFR 1910.94 – *Ventilation*, OSHA
- 29 CFR 1910.106 – *Flammable and Combustible Liquids*
- 29 CFR 1910.107 – *Spray finishing Using Flammable and Combustible Materials*, OSHA
- 29 CFR 1910.169 – *Air Receivers*
- 29 CFR 1910.179 – *Overhead and Gantry Cranes*
- AFOSHSTD 91-501 *Air Force Consolidated Occupational Safety Standard*
- EM 385-1-1 *USACE Safety and Health Requirements Manual*
- OPNAVINST 5100.23 *Series*

3-10.2 Environmental Controls.

The facility must comply with all applicable environmental regulations. The Whole Building Design Guide web site (http://www.wbdg.org/) provides information and links to the various laws and guidance documents pertaining to the environment. For site-specific information, contact the base environmental office and the local Facility Engineering Command.

The type of environmental controls required will depend on the pollution abatement regulations at the site and the type and quantities of paints used. Environmental controls can be a major construction and operating cost item; therefore, an accurate determination of regulations and paints (existing and proposed) is required prior to design. Design must be in accordance with environmental protection regulations per Appendix C.

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CHAPTER 4 MEDIA BLAST HANGAR DESIGN CRITERIA

4-1 FUNCTION.

The basic function of a Dry Media blasting facility is to remove coatings and/or corrosion from aircraft, aircraft components, ground equipment, or other types of equipment in preparation for the application of surface coatings and corrosion treatment. Plastic Media Blast (PMB) media is the most common type of Dry Media Blast (DMB) abrasive used during depot and field level abrasive blasting operations. Other types of abrasive materials are used so design the facility to accept other abrasives.

During blasting operations, abrasives and the surface coatings on the blasted materials are shattered to varying degrees. This generates dust, which may contain particles of respirable size (0 to 5 micrometer). The composition and toxicity of the dust is often a health or combustion hazard.

A blast cleaning room is defined as an enclosed space where the worker operates the blasting nozzle inside with the component. A blasting cabinet is defined as an enclosure where the operator stands outside and operates the blasting nozzle through an opening or openings in the enclosure of the cabinet. This chapter defines requirements for facilities which are sized to accommodate entire aircraft. For Blast Cleaning Rooms and/or blasting cabinets, see ref. UFC 3-410-04, *Industrial Ventilation*.

4-2 DMB MATERIAL

4-2.1 DMB Material Combustibility

Data sheets for the Plastic Media blast (PMB) material indicate it is non-combustible at the particle size that the material will be initially used at (a PG-1 size which is 5% > 12 mesh, 12 mesh > 80% > 16 mesh and 16 mesh > 15% > 20 mesh). It is typical for many dusts that are not combustible until they reach a particle size of 420 microns or less in diameter (i.e., material passing through a U.S. No. 40 Standard Sieve). The PMB material behaves in this manner, being combustible when particles are small enough; and thereby having the potential to generate a dust explosion when enough of these very small particles are in a uniform fine suspension in air and are heated to a high enough temperature.

4-2.2 DMB Recovery.

Provide a system and equipment to recover, and reclaim the dry media. The media reclamation design must be in accordance with 29 CFR 1910.94. A pneumatic recovery system is recommended instead of mechanical recovery system for dry media (Mechanical systems tend to abrade the media).

Dust collectors must be set up so that the accumulated dust can be emptied and removed without contaminating other working areas or the workers.

4-2.3 DMB Recycling.

In the DMB process for aircraft stripping functions the blast media is recycled when particles are between 12 and 60 mesh. As particle size becomes smaller (i.e. pass through a 60 mesh sieve) the particles become uneconomical for the stripping process and these smaller particles are removed in the stages one and two of the media reclamation process. As particles between 12 and 60 mesh are recycled, some of the media that is returned to the stripping process falls in the particle size range that is combustible (i.e. between 40 and 60 mesh for the plastic media currently in use).

The following system elements are also required:

- Do not integrate the exhaust ventilation system with the media recovery system
- Protect the media recovery system and ductwork from moisture and rainwater intrusion to keep the media from caking and plugging up the system.
- Use a pneumatic recovery system instead of mechanical recovery system for plastic media. (Mechanical systems tend to abrade the media.)

4-2.4 PMB Hangar Cautions.

The premise of the building design is that the system interlocks, media recovery, media recycling, interior space design and housekeeping policies must be such to minimize the amount of small dust particles that may accumulate anywhere in the hangar. The Interior design must emphasize the exclusion of horizontal areas where dust may settle. However, due to the constant generation of this dust, specifically during the depaint process, the space must be rated as hazardous for dust, as absolute control over dust buildup is difficult to achieve. Designers must be aware that PMB materials in a laboratory setting have been shown to form dust clouds that can result in dust explosions. Research reports by US Bureau of Mines have concluded that:

- As delivered PMB material is not hazardous with respect to potential explosion hazard. This refers to material in the 12-16 Mesh size range when delivered, and 12-60 Mesh size range when recycled.
- In PMB media where all material is fine i.e. below 40 Mesh, an explosion is possible under some conditions in an explosive test chamber with a spark igniter.
- In PMB where all material is very fine i.e. all below 140 Mesh, an explosion is likely in an explosive test chamber with a spark igniter.

4-3 WASH RACKS FOR DMB OPERATIONS.

The Aerospace NESHAP requires residual dust resulting from de-painting by DMB be completely removed. In response to this requirement, locate a Wash Rack as close as practical to the Dry Media De-paint Hangar and include this in the planning phase of a new DMB DF. Note that the DMB hangar itself must not be used for the aircraft wash process.

4-4 ARCHITECTURAL AND STRUCTURAL REQUIREMENTS.

Design each hangar for the size and configuration of the specific aircraft to be handled. Determine work-bay dimensions, ceiling heights, and door openings by the aircraft dimensions. Determine the number of work-bays by the workload. In addition to the following specific requirements, design the DMB Depaint hangar using the general architectural criteria set forth in Chapter 3.

4-4.1 Interior Surfaces

In addition to the requirements in Chapter 3, blast bay must be a fully lined and sealed space with hard, light-colored, smooth, surface provided on walls, inside surfaces of doors, and ceilings; all joints sealed, and doors made weather tight to prevent migration of dust into the cavity behind the wall or ceiling. Horizontal surfaces and ledges (Cabinet tops or beam flanges) must be covered with a sloping surface such that the accumulation of dust is mitigated.

4-4.2 Use Group Classifications.

DMB hangar bay area must be classified by the IBC as a Factory and Industrial use group F-1.

4-4.3 Other Architectural Requirements

- Isolate the abrasive blasting operations from other processes, functions, and activities to eliminate contamination.
- Doors on blast bays must be operable from both inside and outside, except that where there is a small operator access door, the large work access door may be closed or opened from the outside only
- An observation window and an access door(s) must be provided in accordance with 29 CFR 1910.94 and AIHA Z9.4. Position the observation window(s) in the hangar bay walls as required to allow for continuous observation of the workers inside the hangar bay from outside the space. Provide the number of doors and windows as appropriate for the size of the hangar bay
- Provide emergency exits on opposing walls. Make sure personnel doors are operable from both inside and outside of the room. Doors must be flanged and tight when closed.

4-5 MECHANICAL REQUIREMENTS.

Design the DMB De-paint Hangar to meet the criteria set forth in Chapter 3, with the following special requirements:

4-5.1 Plumbing.

Industrial waste drainage system must not be installed inside a DMB Depaint hangar bay. No floor drains are to be installed in the hangar floor.

4-5.2 Ventilation for Control of Air Contaminants.

Determine the type of dust hazard and the minimum average air velocity through the blasting enclosure in accordance with 29 CFR 1910.94. The ventilation systems must be specifically designed to remove dust in the combustible particle size range.

Blast-cleaning enclosures must be exhaust ventilated in such a way that a continuous inward flow of air will be maintained at all openings in the enclosure during the blasting operation.

The air exhausted from blast-cleaning equipment must be discharged through dust collecting equipment.

Interlock the ventilation system with the blasting equipment power supply. This will prevent the use of the blasting equipment without proper ventilation controls.

4-5.3 Noise and Vibration Control.

Design mechanical systems and equipment to limit noise and vibration in accordance with UFC 3-450-01. The DMB Depaint operation and the media support equipment generate significant levels of noise by the nature of the process. Special design emphasis therefore must be placed on separating the DMB spaces from the non-DMB occupied spaces to ensure proper sound levels are maintained through out the facility.

4-6 ELECTRICAL REQUIREMENTS.

Design the DMB Depaint Hangar to meet the criteria set forth in Chapter 3 GENERAL DESIGN CRITERIA with the following special requirements:

4-6.1 Hazardous Classification.

Due to the constant presence of dust generated by the DMB depaint process, the potential exists for there to develop an explosive atmosphere in the hangar bay at certain times during the DMB operation, regardless of the emphasis on dust mitigating design and housekeeping diligence. Therefore, the hangar bay must be classified as a Class 2, Division 1 space per NFPA 70.

4-6.2 Grounding.

Provide grounding in accordance with UFC 3-575-01, *Lightning and Static Electricity Protection Systems.*

4-7 FIRE PROTECTION.

DMB Depaint operations are performed only on defueled aircraft. Fire protection requirements for facilities housing only defueled and purged aircraft follow NFPA 409 guidelines which allow the use of sprinkler systems for area protection in the hangar bay. Foam fire protection systems are therefore not necessary for facilities containing aircraft that are defueled and purged or have their fuel cells removed. Aircraft entering sprinkler protected hangar bays must have all fuel tanks defueled and purged. Signs must be installed on all access doors and hangar doors stating “NO FUELED AIRCRAFT” for facilities with sprinkler protection only in the hangar bay.

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CHAPTER 5 CHEMICAL DEPAINT DESIGN CRITERIA

5-1 GENERAL DESIGN REQUIREMENTS.

ACCPF designed in accordance with Chapter 3 of this document will generally be able to meet the criteria required for chemical depaint operations. Special attention must be given to the interior surfaces (floors, walls, ceilings, trenches, pits) that could come in contact with the paint removal solution due to the inherent corrosive properties of the chemicals. Also, the chemical depaint solution is considered toxic and with the removed paint hazardous waste, requiring specific industrial waste treatment to maintain the mandated zero discharge or meet the input requirements of the Industrial Waste Treatment Plant serving the facility.

5-2 CHEMICAL DEPAINT (ONLY) FACILITIES.

Ventilation air requirements for chemical depaint only facilities may be reduced from a paint finishing facility due to the reduced flammability and toxicity of the current paint removal processes. This evaluation will require 1) exclusion of the depaint facilities from paint spray operations and 2) verification of the reduced flammable properties of the depaint solution and 3) concurrence from the authorities having jurisdiction. The depaint solution will also require evaluation with respect to toxicity for required ventilation and PPE for personnel protection.

5-3 DRAINAGE SYSTEMS FOR CHEMICAL DEPAINT.

The hangar floor drainage system for a chemical depaint facility fully capable of chemical stripping an entire aircraft must incorporate a trench and piping design that has sufficient diameter and slope to carry all paint chips and residue to a collection/holding tank. Trenches in the hangar must be sized with sufficient width to facilitate cleanout on a regular basis. The tank must be sized for a three month projection of activity, assuming that all removed paint will go through the system. The tank must be capable of being emptied of the paint residue manually or automatically. Regardless of the removal means, proper access must be designed into the tank to permit manual clean out and/or inspection.

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CHAPTER 6 AIRCRAFT WASH RACKS

6-1 INTRODUCTION.

Aircraft Wash Racks are paved areas or facilities provided at all aircraft base facilities for the purpose of cleaning aircraft in conjunction with periodic maintenance and corrosion control activities.

6-2 DESIGN CRITERIA.

Design aircraft wash racks in accordance with UFC 3-260-01, *Airfield and Heliport Planning and Design*.

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CHAPTER 7 SPECIFIC DESIGN CRITERIA

7-1 INTRODUCTION.

This chapter identifies the specific design needs for the individual spaces. Building design criteria are provided in a standard Functional Data Sheet (FDS) table format that generally follows the Uniformat II/Work Breakdown Structure. The Interior Construction/Built-in Equipment category includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, window treatments, laundry machines, and retractable overhead screens. The Furnishings and Equipment category includes loose/moveable items.

7-2 BUILDING DESIGN CRITERIA.

TABLE 7-1. AIRCRAFT HANGAR BAY(PAINT/WASH/CHEM. DEPAINT)

Description/ Usage	Houses aircraft and equipment anticipated for the mission of Facility. The bay must be sized for the largest aircraft with additional space for anticipated maintenance platforms and equipment. The bay must also include utility connections required for the mission. Utilities will vary for paint application, and chemical depaint versus dry depaint.
Ceiling Ht.	Based on largest aircraft. See required clearances above aircraft.
Windows/Doors	Translucent panels for day lighting in exterior walls; tempered glass windows in hollow metal frames between supervisors' offices and Hangar Bay; supply plenum in hangar doors for cross-flow hangar; heavy duty hollow metal personnel doors and frames with closers, included in hangar doors as required for exiting; factory-finished galvanized steel coiling doors at larger openings; insulated doors between conditioned and unconditioned spaces; openings between Hangar Bay and adjacent spaces protected per code requirements; STC ratings of windows and doors must match that required for walls
Interior Construction/ Built-in Equipment	Interior walls, painted CMU or metal liner panels from floor to 7'-0" (2.1 m) min., rated as required per code; walls between hangar bays rated as required by NFPA 409; cranes and teleplatforms as required by mission requirements
Finishes	**Walls.** Factory finished metal liner panels or painted CMU from floor to 7'-0" (2.1 m) minimum; Block filler must be applied to CMU prior to painting; metal panels above advisable where budget allows or where required for linear air flow **Floor.** Dry shake hardener on concrete is minimum requirement. Coating must provide smooth, easily cleanable surface that will not accumulate dust; verify coating compatibility with chemical strippers and other chemicals that may be present; follow coating manufacturers' recommendations for sealing and bridging concrete joints. **Base.** - **Ceiling.** Exposed construction, painted. Metal panel advisable where budget allows or where required for linear air flow; provide draft curtains as required by NFPA 409
Plumbing	Emergency Showers and Eyewashes, floor drains to IW system
HVAC	See Chapter 3 for requirements as appropriate for paint spray application
Fire Protection and Life Safety	HEF/AFFF for fueled aircraft; Per NFPA 409 for Defueled aircraft
Power	Convenience outlets, dedicated equipment outlets ;aircraft ground power connections Classified area Class1, Div.1, Group C
Ground	Aircraft static grounding system required

TABLE 7-1. AIRCRAFT HANGAR BAY(PAINT/WASH/CHEM. DEPAINT)

Lighting	HID
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Public address** – Required, origination in Supervisor's Office **Security.**
Acoustics	Minimum STC 40 assemblies between Hangar Bay and adjacent normally occupied spaces
Furnishings and Equipment	
Special Requirements	Avoid ledges and other horizontal surfaces that are capable of collecting dust.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-2. AIRCRAFT HANGAR BAY (DMB DEPAINT)

Description/ Usage	Houses aircraft and equipment anticipated for the mission of Facility. The bay must be sized for the largest aircraft with additional space for anticipated maintenance platforms and equipment. The bay must be designed for a dusty environment and include strategically placed outlets for Dry Media Blast (DMB) distribution and spent DMB pick up /delivery system for DMB reclamation; with additional utilities specific for the mission.
Ceiling Ht.	Based on largest aircraft. See required clearances above aircraft.
Windows/Doors	Translucent panels for daylighting in exterior walls; tempered glass windows in hollow metal frames between supervisors' offices and Hangar Bay; supply plenum in hangar doors for cross-flow hangar; heavy duty hollow metal personnel doors and frames with closers, included in hangar doors as required for exiting; factory-finished galvanized steel coiling doors at larger openings; insulated doors between conditioned and unconditioned spaces; openings between Hangar Bay and adjacent spaces protected per code requirements; STC ratings of windows and doors must match that required for walls
Interior Construction/ Built-in Equipment	Interior walls, painted CMU from floor to 7'-0" (2.1 m) min., rated as required per code; walls between hangar bays rated as required by NFPA 409; cranes and teleplatforms as required by mission requirements
Finishes	**Walls.** Factory finished metal liner panels or painted CMU from floor to 7'-0" (2.1 m) minimum. Factory finished metal wall panels to ceiling. Block filler must be applied to CMU prior to painting. **Floor.** Dry shake hardener is minimum requirement. Coating must provide smooth, easily cleanable surface that will not accumulate dust **Base.** - **Ceiling.** Factory finished metal liner panels

TABLE 7-2. AIRCRAFT HANGAR BAY (DMB DEPAINT)

Plumbing	Emergency Showers & Eyewashes, no floor drains
HVAC	See Chapter 3 for requirements appropriate for DMB De-paint operation
Fire Protection and Life Safety	Per NFPA 409 for Defueled aircraft
Power	Convenience outlets, dedicated equipment outlets ;Aircraft ground power connections HZD Loc-Class II, Div.1, Group G for dusty environment
Ground	Aircraft static grounding system required
Lighting	HID
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Public Address –**Required, origination in Supervisor's Office **Security.**
Acoustics	Minimum STC 40 assemblies between Hangar Bay and adjacent normally occupied spaces
Furnishings and Equipment	
Special Requirements	Avoid ledges and other horizontal surfaces that are capable of collecting dust.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-3. PAINT MIX ROOM

Description/ Usage	Coating mix and paint pot staging; adjacent to paint storage with easy access to paint bay.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames, rated as required by code
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code
Finishes	**Walls.** Painted CMU. Block filler must be applied to CMU prior to painting. **Floor.** applied to concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system; containment or trenches to IW at doors; compressed air for CA powered paint shakers(optional)
HVAC	Heating, ventilation and cooling required and per NFPA 33
Fire Protection and Life Safety	Required per NFPA 33 and NFPA 101

TABLE 7-3. PAINT MIX ROOM

Power	Convenience outlets; Space classified Class 1 Div 1
Ground	Required - Ground connections for equipment
Lighting	Fluorescent (Hzd Loc-Class 1,div 1)
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Public Address -** Speaker **Security.**
Acoustics	Minimum STC 40 assemblies between Paint Mix and adjacent normally occupied spaces
Furnishings and Equipment	Provide built-in counters as required for paint mix equipment
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft² (m²)	

TABLE 7-4. PAINT STORAGE ROOM

Description/ Usage	Aircraft coating container storage; adjacent to paint mix, with curbed storage area drained to I.W.; should also have access for deliveries.
Ceiling Ht.	As required to accommodate storage and material handling equipment
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors, rated as required by code; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other material handling equipment
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code; extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only; provide protection from impact by forklift or other material handling equipment
Finishes	**Walls.** Painted CMU or factory finished metal panels. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system; containment or trenches to IW at doors
HVAC	Heating, ventilation and cooling required and per NFPA 33
Fire Protection and Life Safety	Required per NFPA 33 and NFPA 101
Power	Convenience Outlets
Lighting	Fluorescent (Hzd Loc-Class 1,div 2)

TABLE 7-4. PAINT STORAGE ROOM

Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Drum racks, pallet racks and cabinets for storage as requested by facility users
Special Requirements	Provide storage conforming to applicable flammable and combustible liquids codes and standards
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-5. TOOL CRIB

Description/ Usage	Special use equipment tools such as pallet jacks, ladders, facility maintenance items.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other equipment; provide tool issue window and counter with rolling service counter door as required by facility users
Interior Construction/ Built-in Equipment	CMU walls or wire mesh partitions as required by facility users, extending to roof or ceiling above
Finishes	**Walls.** Painted CMU or galvanized wire mesh partitions. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete as minimum requirement **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	

TABLE 7-5. TOOL CRIB

Furnishings and Equipment	Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets, parts storage bins. Coordinate the quantities of furniture with the users. Other types of furniture may be required based on user and airframe type utilizing the hangar.
Special Requirements	Due to the potentially large pieces of equipment brought into this shop, a rolling service door is recommended in lieu of double doors opening onto the hangar bay. Door must be at least 5 feet (1.52 m) wide and 6'-8" (2.03 m) high. If a 4' (1.22 m) wide opening is adequate, provide a single 4' (1.22 m) wide personnel door in lieu of double doors. Consider using modular rolling storage shelving units for large tool rooms.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-6. EQUIPMENT STORAGE

Description/ Usage	Paint application equipment storage; typically combined with paint equipment cleaning room.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest equipment
Interior Construction/ Built-in Equipment	CMU walls or wire mesh partitions as required by facility users, extend to roof or floor structure above; if combined with equipment cleaning, may require rated walls and/or electrical classification
Finishes	**Walls.** Painted CMU or galvanized wire mesh partitions. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete as minimum requirement; users may require thin film coating such as epoxy **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Steel shelves and storage cabinets as required by facility users

TABLE 7-6. EQUIPMENT STORAGE

Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-7. EQUIPMENT CLEANING

Description/ Usage	Paint application equipment cleaning; room generally contains small paint booth or other solvent cleaning apparatus for use with paint spray guns and paint pots.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames, rated as required by code
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code
Finishes	**Walls.** Painted CMU. Block filler must be applied to CMU prior to painting. **Floor.** Sealer or thin film coating applied to concrete as requested by facility users **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Industrial Ventilation	See UFC 3-410-04, *Industrial Ventilation*, for requirements if small non walk-in paint spray or cleaning booth is present.
Fire Protection and Life Safety	Required
Power	Convenience Outlets; power to optional specialized cleaning booths
Lighting	Fluorescent
Communication	**Telephone.** Required **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Electrical classification may be required in vicinity of solvent cleaning equipment
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-8. SOLVENT STORAGE

Description/ Usage	Large container (typ 55 gal) paint solvent storage; requires pallet storage with door openings and aisles suitable for deliveries.
Ceiling Ht.	As required to accommodate storage and material handling equipment
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors, rated as required by code; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other material handling equipment
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code; extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only; provide protection from impact by forklift or other material handling equipment
Finishes	**Walls.** Painted CMU or factory finished metal panels. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete or thin film coating as requested by facility users; coating to be resistant to solvents stored. **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system; containment or trenches to IW at doors
HVAC	Heating and ventilation required and per NFPA 33
Fire Protection and Life Safety	Required per NFPA 33 and NFPA 101
Power	Convenience outlets; Space classified Class II Div 1
Lighting	Required - Ground connections for solvent containers
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Drum racks, pallet racks and cabinets for storage as requested by facility users
Special Requirements	Provide storage conforming to applicable flammable and combustible liquids codes and standards
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-9. CENTRAL ACID STORAGE

Description/ Usage	Central storage for acid cleaner and conversion coating; may include central chemical mix and storage tanks with pumps and piping for distribution to the hangar bay.
Ceiling Ht.	As required to accommodate storage tanks and equipment
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors, rated as required by code; provide double doors or overhead coiling doors as required to accommodate material and equipment movement
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code; extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only
Finishes	**Walls.** Painted CMU or factory finished metal panels. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system; containment or trenches to IW at doors
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Allow space for maintenance, repair and replacement of equipment
Special Requirements	Conform to applicable codes and standards regarding hazardous materials storage
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-10. CENTRAL CHEMICAL STORAGE

Description/ Usage	Central storage/distribution for hot soap/water mix and hot and cold water; typically includes bulk storage of concentrated soap, central hot water heater/tank, soap/HW mix tank and associated distribution pumps.
Ceiling Ht.	As required to accommodate storage tanks and equipment
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors, rated as required by code; provide double doors or overhead coiling doors as required to accommodate material and equipment movement
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code; extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only
Finishes	**Walls.** Painted CMU or factory finished metal panels. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system; containment or trenches to IW at doors
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Allow space for maintenance, repair and replacement of equipment
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-11. MATERIAL STORAGE

Description/ Usage	Secure storage of non-hazardous paint prep materials; typically includes a window for distribution of materials to paint personnel; may also include storage of paint process equipment and parts.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other equipment; provide tool issue window and counter with rolling service counter door as required by facility users
Interior Construction/ Built-in Equipment	CMU walls or wire mesh partitions as required by facility users, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or galvanized wire mesh partitions. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete as minimum requirement **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping.
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets, parts storage bins. Coordinate the quantities of furniture with the users. Other types of furniture may be required based on user and airframe type utilizing the hangar.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-12. PPE STORAGE

Description/ Usage	Room/area designated for secure storage of PPE; storage of PPE is typically combined with PPE cleaning.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames
Interior Construction/ Built-in Equipment	CMU walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU. Block filler must be applied to CMU prior to painting. **Floor.** Sealer or thin film coating applied to concrete as requested by facility users **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Steel shelves and storage cabinets as required by facility users
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-13. PPE CLEANING

Description/ Usage	Cleaning of personnel protective equipment; typically includes divided sinks; central washer and drier (optional).
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames
Interior Construction/ Built-in Equipment	CMU walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU. Block filler must be applied to CMU prior to painting. **Floor.** Sealer or thin film coating applied to concrete as requested by facility users **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Hot and cold water; laundry sink; clothes washer and drier connections; floor drains to IW System
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area; clothes drier exhaust to the exterior
Fire Protection and Life Safety	Required
Power	Convenience Outlets; power for Washer and Drier
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-14. PAINT BOOTH

Description/ Usage	Individual paint spray booth for small parts (may be located inside hangar bay or exterior to building).See UFC 3-410-04 Industrial Ventilation for specifications and facility requirements
Ceiling Ht.	Based on largest part anticipated, with sufficient clearances for movement of personnel and equipment
Windows/Doors	Supply plenum and/or paint filters in doors for cross-flow booth; size doors to accommodate movement of parts; heavy duty hollow metal personnel doors and frames with closers; insulated doors between conditioned and unconditioned spaces;
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** Factory finished metal panels **Floor.** Thin film coating or dry shake hardener is minimum requirement. Coating must provide smooth, easily cleanable surface that will not accumulate dust **Base.** - **Ceiling.** Factory finished metal panels
Plumbing	Drains, if installed must be routed to IW systems for proper treatment. Emergency Shower & Eyewash, floor drains to IW system
Industrial Ventilation	For Paint Booths exhausted to the exterior installed in interior spaces, replacement air must be supplied to the space to maintain an even static pressure. See UFC 3-410-04 Industrial Ventilation for further information on Paint Booth ventilation.
HVAC	See UFC 3-410-04 Industrial Ventilation for information on Paint Booth ventilation.
Fire Protection and Life Safety	See NFPA 33 for Paint Booth Fire Protection requirements
Power	Power receptacles, if required inside the space must be rated Class 1, Div 1 for hazardous spaces.
Lighting	Provide lighting in ceiling and walls as required; light fixtures must be Class I, Division 1 rated; lamps must be capable of replacement either from inside booth or sufficient space and structure must be provided to allow replacement from exterior.
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Provide separate structure, exterior wall panels and roof panels if booth is not located in a hangar or other enclosed building; allow sufficient clearance for movement and maintenance around exterior of booth, but not less than 5 feet (1.5 m)
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-15. STENCIL ROOM

Description/ Usage	Houses aircraft stencil equipment; room size should consider size of aircraft stencils as well as equipment.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Resilient tile or sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets; special power for stencil equipment as required.
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Stools, tables and work benches should be provided as required for layout and trimming of stencils; drawers and shelving should be provided for storage of stencils and tools
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-16. COMPOSITE ROOM

Description/ Usage	Composite/fiberglass layup/repair room will typically contain work benches with ventilation hoods, and curing ovens for repair of composite parts.
Ceiling Ht.	As required to accommodate movement of largest parts and equipment
Windows/Doors	Heavy duty hollow metal doors and frames,
Interior Construction/ Built-in Equipment	Extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only
Finishes	**Walls.** Painted CMU. Block filler must be applied to CMU prior to painting. **Floor.** Sealer or thin film coating applied to concrete as requested by facility users **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system
Industrial Ventilation	See UFC 3-410-04, Industrial Ventilation, for requirements.
HVAC	Special temperature and humidity controls may be required based on type of composite.
Fire Protection and Life Safety	Required
Power	
Lighting	
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-17. WASH RACK

Description/ Usage	Accommodates aircraft cleaning and can be open, covered, enclosed, or integrated into the hangar bay.
Ceiling Ht.	Based on largest aircraft. See required clearances above aircraft.
Windows/Doors	-
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** - **Floor.** - **Base.** - **Ceiling. -**
Plumbing	Safety Shower and Eye Wash(number as appropriate to WR size), floor drains to IW System
HVAC	As appropriate for type of Wash Rack; heating and ventilation required for enclosed spaces
Fire Protection and Life Safety	Fire Protection required for enclosed spaces
Power	Convenience outlets with specialized outlets as required for aux. portable equipment
Lighting	HID or Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Fall protection requirements are applicable to all Wash Racks, open or covered.
Special Requirements	Facility must have Hot water and Cold Water
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-18. SUPERVISOR'S OFFICE

Description/ Usage	Private office located with view of hangar bay
Ceiling Ht.	9 ft.
Windows/Doors	Window to hangar bay protected as required by code; medium duty hollow metal or solid core wood door in hollow metal frame; access via corridor, direct hangar bay access not allowed
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile, heavy duty carpet tile or sealed concrete. **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience and work station Outlets
Lighting	Fluorescent
Communication	**Telephone.** Required **Data.** Required **CCTV.** **CATV.** **Security.** **Public Address –** System cabinet with Microphone
Acoustics	
Furnishings and Equipment	Standard office furnishings and equipment
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-19. OFFICES General

Description/ Usage	Private offices and/or workstations determined by mission requirements
Ceiling Ht.	9 ft. (2.7 m)
Windows/Doors	Window to hangar bay, if provided, protected as required by code; medium duty hollow metal or solid core wood door in hollow metal frame; access via corridor, direct hangar bay access not allowed
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile or carpet tile **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience and work station outlets
Lighting	Fluorescent
Communication	**Telephone.** Required **Data.** Required **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Standard office furnishings and equipment
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-20. CONFERENCE ROOM

Description/ Usage	Small assembly with conference table and chairs
Ceiling Ht.	9 ft. (2.7 m)
Windows/Doors	Window to hangar bay, if provided, protected as required by code; medium duty hollow metal or solid core wood doors in hollow metal frame; access via corridor, direct hangar bay access not allowed
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile or carpet tile **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets; Power and Cable connection in Ceiling for projector
Lighting	Fluorescent
Communication	**Telephone.** Required **Data.** Required **CCTV.** Required **CATV.** Required **Security.** **Public Address** Required
Acoustics	
Furnishings and Equipment	Conference table and chairs; white board
Special Requirements	Room should be fitted for Audio/Visual presentations with built in speaker system, projector, and retractable viewing screen or equivalent media presentation equipment.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-21. FAX/COPY

Description/ Usage	Centralized fax/copy room
Ceiling Ht.	9 ft. (2.7 m)
Windows/Doors	Solid core wood door in hollow metal frame (optional)
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area; review ventilation requirements for copy equipment, exhaust to exterior may be required
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Standard reproduction/printing equipment as requested by users; built in cabinets for storage of paper and other supplies
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-22. BREAK ROOM

Description/ Usage	Personnel break and assembly room
Ceiling Ht.	9 ft. (2.7 m)
Windows/Doors	Window to hangar bay protected as required by code; heavy duty hollow metal or solid core wood door in hollow metal frame.
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	Sink, with water supply and drain piping
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-23. LOCKER ROOMS(CLEAN)

Description/ Usage	Male and female locker/shower/toilet facilities used for storage of operators' personal items
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal or solid core wood door in hollow metal frame; access via corridor, direct hangar bay access not allowed
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** Glazed ceramic tile on CMU **Floor.** Unglazed ceramic tile **Base.** Ceramic tile **Ceiling.** Suspended acoustical panels with moisture-resistant finish
Plumbing	Flush valve toilets, flush valve urinals, countertop or wall mounted lavatories, showers, floor drains
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets, GFI protected
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	Minimum STC 40 assemblies between Locker Rooms and adjacent normally occupied spaces
Furnishings and Equipment	
Special Requirements	Number of fixtures will be determined by the RFP preparer for design build projects or must provide adequate information for the Design Builder to establish the correct number of fixtures required. Provide 2 tier-1/2 height lockers on concrete base. RFP preparer must determine the number of lockers required. Lockers must be sized based on activity requirements. Provide number of accessible fixtures required
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-24. LOCKER ROOMS(DIRTY)

Description/ Usage	Male and female lockers used for disposition contaminated clothing worn by operators during the performance of their corrosion control duties
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal or solid core wood door in hollow metal frame; access via PPE staging/cleaning area to clean locker room; direct hangar bay or clean corridor access not allowed
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** Glazed ceramic tile on CMU **Floor.** Unglazed ceramic tile **Base.** Ceramic tile **Ceiling.** Suspended acoustical panels with moisture-resistant finish
Plumbing	Hand washing facilities, floor drains
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets, GFI protected
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	Minimum STC 40 assemblies between Locker Rooms and adjacent normally occupied spaces
Furnishings and Equipment	
Special Requirements	Provide 2 tier-1/2 height lockers on concrete base. RFP preparer must determine the number of lockers required. Lockers must be sized based on activity requirements.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-25. TECHNICAL LIBRARY

Description/ Usage	Storage of aircraft technical documents
Ceiling Ht.	9 ft. (2.7 m)
Windows/Doors	Solid core wood door in hollow metal frame
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile or carpet tile **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** Required **Data.** Required **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Shelves and cabinets for documents; tables and chairs, as required; computer and telephone
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-26. MAINTENANCE SHOPS

Description/ Usage	Optional mission-specific maintenance spaces
Ceiling Ht.	As required for the specific maintenance operation
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other equipment
Interior Construction/ Built-in Equipment	CMU walls and/or wire mesh partitions as required by facility users, extend to roof or ceiling above
Finishes	**Walls.** Painted CMU or galvanized wire mesh partitions. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete as minimum requirement **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	As required; Emergency eyewash/showers may be required depending on processes performed and materials used; floor drains to IW
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	To be determined by mission and specified by RFP writer
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-27. MECHANICAL ROOM(S)

Description/ Usage	HVAC and misc mechanical systems
Ceiling Ht.	As required to accommodate equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU or gyp. bd. and metal stud walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Floor drains
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience outlets plus equipment power
Lighting	Fluorescent
Communication	**Telephone.** **Data.** Connection to EMCS as required for energy monitoring. **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Provide sufficient clearance around equipment for repair and replacement of key components.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-28. COMPRESSOR ROOM

Description/ Usage	Plant air and breathing air compressor systems .Note specific requirements for Breathing Air vs. Plant Air
Ceiling Ht.	As required to accommodate the equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU or gyp. bd. and metal stud walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Floor drains
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	
Lighting	
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Provide sufficient clearance around equipment for repair and replacement of key components.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-29. CENTRAL PLANT

Description/ Usage	Centralized chilled water and heating hot water supply
Ceiling Ht.	As required to accommodate the equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU or gyp. bd. and metal stud walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp.board. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Floor drains
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience outlets plus equipment power
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Provide sufficient clearance around equipment for repair and replacement of key components.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-30. ELECTRICAL ROOM(S)

Description/ Usage	Switchboards, motor control centers, distribution transformers, circuit breaker and lighting panels, VFD equipment
Ceiling Ht.	As required to accommodate equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overheard coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU or gyp. bd. and metal stud walls as required by facility users, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	As required for heat load from electrical gear
Fire Protection and Life Safety	Required
Power	Convenience outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-31. FIRE PROTECTION ROOM

Description/ Usage	Fire water riser, distribution manifold, AFFF or HEF storage tanks
Ceiling Ht.	As required to accommodate tanks, equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU or gyp. bd. and metal stud walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Floor drains
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-32. COMMUNICATION ROOM

Description/ Usage	Telephone switchboard and misc communications equipment
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames; provide double doors if required to accommodate equipment racks
Interior Construction/ Built-in Equipment	CMU or gyp.board. and metal stud walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-33. DRY MEDIA EQUIPMENT ROOM

Description/ Usage	Centralized dry blast media retrieval, processing and distribution equipment
Ceiling Ht.	As required to accommodate equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU; block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience Outlets; power as required for DMB Depaint Equipment
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-34. DRY MEDIA STORAGE ROOM

Description/ Usage	Bulk dry media storage (palletized)
Ceiling Ht.	As required to accommodate storage and material handling equipment
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other material handling equipment
Interior Construction/ Built-in Equipment	Extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only; provide protection from impact by forklift or other material handling equipment
Finishes	**Walls.** Painted CMU or factory finished metal panels. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Include means of media handling, including hopper filling
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-35. DRY MEDIA BLAST BOOTH

Description/ Usage	Fully enclosed self contained room specifically designed with the equipment and utilities for the removal of coatings by the DMB method, generally manually performed by a DMB nozzle operator stationed inside the booth. See UFC 3-410-04 Industrial Ventilation for specifications and facility requirements
Ceiling Ht.	Based on largest part anticipated, with sufficient clearances for movement of personnel and equipment
Windows/Doors	Supply plenum and/or dust collection filters in doors for cross-flow booth; size doors to accommodate movement of parts; heavy duty hollow metal personnel doors and frames with closers; insulated doors between conditioned and unconditioned spaces;
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** Factory finished metal panels **Floor.** Thin film coating or dry shake hardener is minimum requirement. Coating must provide smooth, easily cleanable surface that will not accumulate dust **Base.** - **Ceiling.** Factory finished metal panels
Plumbing	Emergency Shower & Eyewash; no floor drains
Industrial Ventilation	See UFC 3-410-04, *Industrial Ventilation*, for requirements
HVAC	Ventilation
Fire Protection and Life Safety	Required
Power	Class 2, Div 1 if provided
Lighting	Provide lighting in ceiling and walls as required; light fixtures must be Class II, Division 1 rated; lamps must be capable of replacement either from inside booth or sufficient space and structure must be provided to allow replacement from exterior
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

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APPENDIX A REFERENCES

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OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

29 CFR 1910.94, *Ventilation*, http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9734

29 CFR 1910.106, *Flammable and Combustible Liquids,* http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9752&p_table=STANDARDS

29 CFR 1910.107, *Hazardous Materials, Spray Finishing Using Flammable and Combustible Materials,* http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9753&p_text_version=FALSE

29 CFR 1910.134, Respiratory Protection, http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=12716

29 CFR 1910.169, *Air Receivers,* http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9823

29 CFR 1910.179, *Overhead and Gantry Cranes,* http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9830

29 CFR 1926.502, *Fall Protection Systems Criteria and Practices,* http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10758&p_table=STANDARDS

OSHA Pub 3048, *Noise Control – A Guide for Workers and Employees*

UNIFIED FACILITIES CRITERIA
(http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)

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

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

UFC 3-101-01, *Architecture*

UFC 3-260-01, *Airfield and Heliport Planning and Design*

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UFC 3-401-01, *Mechanical Engineering* (targeted for publication in July 2012)

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UFC 3-410-02, *Lonworks (R) Direct Digital Control for HVAC and Other Local Building Systems*

UFC 3-410-04, *Industrial Ventilation*

UFC 3-420-01, *Plumbing Systems*

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UFC 4-121-10N*, Design: Aircraft Fixed Point Utility Systems*

UFC 4-211-01N*, Aircraft Maintenance Hangars: Type I, Type II, and Type III*

UFC 4-451-10N, *Design: Hazardous Waste Storage*

UFC 4-832-01N*, Industrial and Oily Wastewater Control*

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(http://www.wbdg.org/ccb/browse_org.php?o=70)

UFGS 08 34 16, *Corrosion Control Hangar Doors*

NON-GOVERNMENT PUBLICATIONS

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS
1330 Kemper Meadow Drive, Cincinnati, OH 45240, www.acgih.org

ACGIH *Industrial Ventilation, A Manual of Recommended Practice*

American Industrial Hygiene Association
3141 Fairview Park Drive, Suite 777, Falls Church, VA 22042, www.aiha.org

AIHA Z9.4, *Abrasive-Blasting Operations - Ventilation and Safe Practices for Fixed Location Enclosures*

AMERICAN NATIONAL STANDARDS INSTITUTE
25 West 43rd Street, 4th Floor, New York, NY, 10036, www.ansi.org

ANSI/BHMA A156.13, *Mortise Locks and Latches*

ANSI/AIHA Z9.2, *Fundamentals Governing the Design and Operation of Local Exhaust Systems*

ANSI/AIHA Z9.3, *Spray Finishing Operations - Safety Code for Design, Construction and Ventilation* ANSI/AIHA Z9.4, *Exhaust Systems -- Abrasive-Blasting Operations - Ventilation and Safe Practices*

ANSI /AIHA Z9.7, *Recirculation of Air from Industrial Process Exhaust Systems*

ANSI/CGA G-7.1 *Commodity Specification for Air*

ANSI/ASSE Z359 Fall Protection Code/Standards

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS
1791 Tullie Circle, N.E., Atlanta, GA 30329, www.ashrae.org

ASHRAE 52.2, *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*

ASHRAE 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*

AMERICAN SOCIETY OF TESTING AND MATERIALS
100 Barr Harbor Drive, West Conshohocken, PA, 19428-2959, www.astm.org

ASTM D523, *Standard Test Method for Specular Gloss*

INTERNATIONAL CODE COUNCIL
500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001, www.iccsafe.org

International Building Code (IBC)

NATIONAL FIRE PROTECTION ASSOCIATION
1 Batterymarch Park, Quincy, MA, 02169-7471, www.nfpa.org

NFPA 30, *Flammable and Combustible Liquids Code*

NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*

NFPA 101, *Life Safety Code*NFPA 409, *Standard on Aircraft Hangars*

NFPA 410, *Standard on Aircraft Maintenance*

NATIONAL INSTITUTE OF BUILDING SCIENCES
1090 Vermont Avenue, NW, Suite 700, Washington, DC 20005, www.wbdg.org

Whole Building Design Guide

SOUTHWEST RESEARCH INSTITUTE
6220 Culebra Road, San Antonio, TX, 78238-5166, www.swri.org

System-Level Computational Fluid Dynamics: Advanced CFD Tools to Solve Problems of Operational Conditions, States of Large-Scale Engineered and Natural Systems

STEEL DOOR INSTITUTE
30200 Detroit Road, Westlake, Ohio 44145, www.steeldoor.org

ANSI/SDI A250.8, *Recommended Specifications for Standard Steel Doors and Frames*

APPENDIX B BEST PRACTICES

B-1 INTRODUCTION.

The following material identifies background information lessons learned and other current, good design practices. The designer is expected to review and interpret this guidance and apply the information according to the needs of the project.

B-2 RECOMMENDED DESIGN GUIDANCE

B-2.1 Process Ventilation Systems.

Ventilation Fans – General.

Use centrifugal fans with backward curved blades (non-overloading), whenever possible. Centrifugal fans with radial blades are less efficient, but still acceptable. Place the exhaust fan and outlet ductwork outside of the building.

Ventilation during Spray Paint operations.

The ventilation system for an aircraft corrosion control hangar must be designed to prevent fire and explosion. At a minimum, the volumetric airflow rate must keep the concentration of vapors and mists in the exhaust stream of the ventilation system below the 25 percent of the LEL. A well-designed ventilation system will also reduce paint overspray, help control workers' contaminant exposure, and protect the paint finish. Workers must use appropriate respiratory protection irrespective of the airflow rate. On 8 April 1997 and 1 July 1999, OSHA issued interpretations of 29 CFR 1910.94 and 29 CFR 1910.107 for determining the airflow rate required for an aircraft corrosion control hangars. In accordance with OSHA's interpretation letters, see Appendix D, an aircraft corrosion control hangar must minimally comply with the requirements of NFPA 33 and with Subpart Z of 29 CFR 1910 for hazardous substances. Consideration, however, may be given to reduced or recirculated airflow deviating from the velocity levels stated in 29 CFR 1910.94(c)(6)(i)and 29 CFR 1910.107(6)(5)(i).

NOTE 1. Recirculation of exhaust air may be considered provided requirements of ANSI/AIHA Z9.7, NFPA 33, ASHRAE, and OSHA are met and coordinated approval is received from the Facility Project Team.

NOTE 2. Recirculation of exhaust air or reduced air flow during painting may result in a DeMinimus violation from OSHA. See Appendix D, Fig. D-2 – OSHA Interpretation regarding the DeMinimus violation.

Ventilation during Drying (Curing)

Review the paint drying requirements before specifying temperature and humidity ranges. Although the airflow level may be used for drying or curing, a lower ventilation airflow rate is recommended during drying the Drying (Curing) mode to conserve energy. Recirculation of exhaust air can be used if sufficient outside air is provided to keep the concentration of vapors and mists in the exhaust stream of the ventilation system below the 25 percent of the LEL. Note that the quantity of off gassed vapors is higher early in the drying process, tapering off at the end of the drying cycle. Refer to ANSI/AIHA Z9.7 for exhaust air re-circulation requirement. During the Drying (Curing) process, the hangar must be given the same operational status as the Paint Spray Operation, requiring that all personnel who enter wear the appropriate protective gear for the duration of the Cure cycle. If the ventilation rate is reduced during the Cure cycle, the hangar must be considered unoccupied with restricted access.

Sanding Operations.

Sanding in a space designated for paint spray operations is not recommended. However, if relocating the sanding process is impractical, vacuum exhaust systems must be provided for the sanding tools to minimize the dust generated in the space during sanding operations.

Ventilation Air Flow Study.

A detailed, in-depth analysis must be completed or other historical verification must be provided to prove that the airflow introduced into the paint area will be uniform in distribution and velocity, and that the system can be properly operated for building pressure requirements. Many systems do not perform as anticipated during the design process, due to lack of foresight of real world conditions, the influence of building structure, the air delivery system inlet and outlet conditions, the air exhaust system, the actual aircraft characteristics and surrounding scaffolding and access equipment, among other things. The analysis can be performed by scaled mockup, scaled wind tunnel analysis or Computational Fluid Dynamics (CFD) modeling, among others. The Navy has also specifically endorsed the use of CFD. Refer to OPNAVINST 4790.2. For more extensive information on CFD modeling refer to High Performance Computing Modernization Office (HPCMO), the National Institute for Occupational Safety and Health (NIOSH), the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), the American Society of Mechanical Engineers (ASME), the U.S. General Services Administration (GSA) and the U.S. Environmental protection Agency (EPA) for studies using CFD analysis for industrial ventilation requirements. It is suggested to employ a third party consultant to perform these functions.

B-2.2 Program Planning for Determination of Areas for a New ACCPF.

Gross Area Calculations for Corrosion Control and Paint/Depaint Hangars

Note: for clarity of calculations, all dimensions are in English inch-pound units.

1. Introduction
    a. This method is being provided to allow better accuracy in estimating gross areas by programmers and base project managers. This can be used ahead of, or in conjunction with, developing the Requirements Document. It needs only a minimal amount of information to arrive at a reasonable gross area for programming purposes.

b. There are a large number of required and optional rooms/spaces to be accounted for. In the past, most of these rooms were never identified until late in the process - well after the gross area had been fixed. By providing a list of potential spaces, a series of yes/no decisions can be used to quickly determine the area requirement.

c. The following areas are typical CCF spaces and do not necessarily represent all possibilities. The addition of spaces unique to the specific mission should be reviewed and added to the area total as appropriate.

2. Hangar Bay

a. The hangar bay size is set by the size of the largest aircraft anticipated. To meet UFC requirements, a minimum 10 feet clear to structure is added to each side, front and back of the aircraft dimension (an additional 5 feet is added to account for building structure to arrive at gross area). This creates a rectangular hangar bay.

b. <u>(Aircraft width + 30)x(Aircraft Total Fuselage length + 30) = Hangar Bay (Base Amount)</u>

c. Most medium/large aircraft save space by creating a nose or tail pocket. The dimensions of the pocket are determined by the need to keep a minimum of 15 feet from either the leading or trailing edge of the wing to the pocket; and by the need to keep 15 feet clear on either side of the fuselage/tail within the pocket.

d. This space is subtracted for the hangar bay, but is added back as support spaces below.

e. The physical shape of these pockets is difficult to calculate without significant effort. However, the following calculation will identify the gross square footage that can be carved out by the pockets.

f. <u>(Aircraft Width x Aircraft Length[forward or aft of the wing]) = Hangar Bay (Amount to be Subtracted)</u>

g. Finally, the team must determine if and how much user equipment is to be stored/located within the hangar bay. This may include parking for lifts, process tanks for wash/etch/conversion coatings or wing/tail stands. While the exact position of these items will not be known at this time, the following calculation will allow sufficient GSF.

h. <u>(Process Width x Total Fuselage Length) = Hangar Bay (Process Support)</u>

i. <u>B - F + H = Gross Hangar Area</u>

Note: Some facility missions require the flexibility to house different or multiple aircraft in a single facility. This flexibility requires advanced planning, significant design input and will incur impact to the budget. Careful consideration should be given early in the planning stages to the current and possible future missions to provide the most cost effective facility which fulfills its current mission while requiring minimal retrofit as future projected mission changes occur.

3. Supply Air Plenum/Exhaust Air Plenum
    a. These are usually needed to provide laminar flow, but there are some alternatives where they may not be needed.

    b. The supply air plenum requires space for distributing the air across the cross-section of the aircraft. This space needs to be somewhat larger than the exhaust air plenum.

    c. <u>(Aircraft width + 30) x (25 feet) = Supply Air Plenum Space</u>

    d. <u>(Aircraft width + 30) x (15 feet) = Exhaust Air</u>

4. Air Recirculation Fan Rooms
    a. If air recirculation is used, space is required for the recirculating air fans separate from the exhaust fans.

    b. Assuming an average hangar bay velocity of 60 fpm, 80% recirculation would equal 50 fpm.

    c. Since the actual hangar bay geometry is not known, assume a rectangular space based on the aircraft width times aircraft height.

    d. The area needed is directly proportional to the number of fans and the size of the fans.

    e. For allocating space requirements, the calculation of 20,000cfm/fan and 60sf/fan provides a good estimate of the total area needed. This is in spite of the likelihood that on larger (cargo-size) hangar bays, the fans could be as much as 100,000 cfm/fan and 300sf/fan.

    f. If the space is less than 2000 sf, allocate 2000 sf minimum to ensure accessibility, maintainability, clearance to electrical equipment)

    g. <u>(Aircraft width x Aircraft height) x 50fpm ÷ (20,000 cfm/fan) x 60sf/fan</u>

    h. Adjust the total ventilation and recirculation rate (sub.para. b. above) to the actual application in order to most accurately estimate the area of the Air Recirculation Fan Room.

5. Supply Fan Rooms

a. This space includes both outside air and recirculated air supply fans necessary to provide the total air required across the cross-sectional area of the hangar bay. So, this space is needed regardless of the use of air recirculation.

b. Similar to the Recirculation Fan Rooms analysis, the room size is dependent on the size and number of fans.

c. For gross area calculations, use a conservative 75fpm across the cross-section of the hangar.

d. Due to differences in how the fans operate, this calculation uses 25,000cfm as the match to a 60sf fan requirement.

e. As above, a minimum space allocation of 2000sf should be used to ensure adequate space.

f. <u>(Aircraft width x Aircraft height) x 75fpm ÷ (25,000cfm/fan) x 60sf/fan</u>

g. Adjust the total ventilation rate (sub.para c. above) to the actual application in order to most accurately estimate the area of the Supply Fan Room.

6. Paint Storage

a. Generally, if paint is stored in the facility, sufficient space needs to be provided to allow for two full paint operations (where applicable, this means two full prime and top coat).

b. A standard 50 sf should be allocated for entry into the room

c. Include the room's ventilation system which is required but who's size is generally independent of the actual paint stored.

d. Use 5sf/gallon to determine the room size. This takes into consideration that most paints are 2-component systems and are provided in one- and five-gallon containers with 1-pint to 1-quart for the second component.

e. <u>(Number of gallons to paint two aircraft) x 5 + 50sf</u>

7. Decontamination

a. This includes all space associated with the decontamination process. For very minor corrosion control operations in existing hangars, an alternative decontamination process may be permitted locally but this is not recommended.

b. Size is based on total number of workers since size is mostly determined by the lockers required. Also, one shift is normally 70 - 80% of the total so shower/wash requirements are close to that required for a total number of workers basis. To ensure adequate space for both male and female workers, this calculation sizes the rooms to accommodate up to 100% male and up to a 50/50 male/female ratio. A lower ratio may be considered, but must be at least double your current female population count.

c. To account for air locks, separation walls or other hidden spaces, include a standard 500sf.

d. Use 40sf/worker to account for clean/dirty lockers, showers, wash basins and the above mix of male/female.

e. <u>(Total number of workers on all shifts) * 40 + 500sf</u>

8. Special Allocation
   a. If you have a large number of workers, the room layout will likely become less efficient.

   b. <u>If the number of workers exceeds 25 per shift, add 200sf</u>.

9. Communications Rooms
   a. If the maximum length inside the facility (corner to corner) is less than 290 feet, a single communications room should be adequate for planning gross area. Even if this assumption is later found to be incorrect for other reasons, the small size of the room is covered by other allowances in these calculations.

   b. Generally, the individual services have their own standard for the primary communications room. Since there are very few phone/data requirements compared to the size of the facility, the minimum size will almost always be sufficient.

   c. <u>Use 100sf for the primary communications room, and 80sf for any secondary communications room, unless your service has a different criterion.</u>

10. Wash Rack Equipment
    a. Where the corrosion control facility has an associated wash rack, space must be provided for that equipment within the facility. Note that dry media paint removal requires, under the Aerospace NESHAP, a wash rack either at the facility or within a short distance of it.

    b. The wash rack itself is not addressed here for gross area calculations. Since this is the most common, an interior wash rack facility area is not addressed.

    c. The wash rack equipment includes hot water, hot soap solution, cold water, concentrated soap, pumps, and storage for hoses. Generally, the maintenance space requirements outweigh any differences in quantities to be stored.

d. Use 400sf for wash rack equipment if identified.

11. User Equipment Storage (Adjacent to Hangar Bay)
    a. This includes items that are used in the hangar bay by the user, are contaminated or potentially contaminated, but cannot (for various reasons) be left in the hangar bay itself. Typical items are paint carts, dry media hoses, and similar equipment.

    b. The amount of equipment is dependent on production rates and, consequently, the number of workers per shift.

    c. As with other rooms, there is a fixed requirement for room access and ventilation that adds 200 sf to any other actual requirement.

    d. While highly variable in function, a space allocation of 4sf/person will normally provide adequate storage.

    e. (Number of workers on a shift) x 5 +200)

12. Chemical Storage
    a. This space includes rooms for storing detergents, acids and solvents. For fire safety and other reasons, these are usually separate rooms (very small quantities can be stored in flammable cabinets in a single room).

    b. To account for spill containment, egress and circulation space, use a standard 50sf.

    c. Each 55-gal drum requires 5 sf.

    d. (Number of 55-gal drums) * 5 + 50sf

13. Corridors
    a. For corrosion control and paint/depaint hangars, corridors can become a significant space. In many cases, the site constraints will force a less-efficient room layout. In every case, the need to handle material with a fork lift creates the need for much wider corridors and more space.

    b. Since most rooms are accessed from a corridor (either a personal or material handling), the number of individual rooms is the best guide for determining the space needed.

    c. For basic egress routes, allocate 1000sf in addition to all other requirements.

d. Most rooms will run 10 - 20 feet along a corridor. An average corridor width is around 6' (4' for personnel, 8' for material handling), but shared between rooms on both sides. Use 40sf/room.

e. <u>(Number of Rooms) x 40sf/room + 1000sf</u>

14. Electrical Rooms

a. The single largest load in most corrosion control and paint/depaint hangars is from the fans and hangar lighting. Therefore, the size of the hangar can be used to size the electrical room(s).

b. Most panelboards will be located in other rooms; this room is primarily for switchgear and similar items.

c. Due to the higher risk of electrocution, and to meet egress requirements, greater clearances are needed

d. Use 1% of the hangar bay area, plus a standard allowance of 200sf to cover egress requirements.

e. The addition of process cooling will increase the size of the electrical room, but for ease of use, that space is calculated within the process cooling room.

f. <u>(Hangar Floor Area) * 0.01 + 200sf</u>

15. Storage for supply and exhaust filters

a. If filter replacement is by service contract, this space may still be desirable, but is not critical since the service contractor can be expected to stage the filters ahead of their need.

b. New facilities need to store supply filters, plus NESHAP-compliant exhaust filters (3-stage). A "filter set" is made up of one 24x24 supply filter, one 24x24 paint arrestor area, one 24x24 second-stage filter, and one 24x24 final filter.

c. This calculation is for sizing the room as simply as practical - the actual design will be based on more rigorous mechanical engineering analysis. Presuming horizontal air flow, one set of filters (generally 24x24 size, except for paint arrestor blankets that are rolls) is needed for every 400 to 800 cfm (this gives 100-200 feet per minute through the exhaust filters, which optimizes the number of filters while maintaining laminar air flow). Consult the filter manufacturer to verify NESHAP certified airflow for the proposed paint arrestor exhaust filters.

d. At the least, it is likely that a set of filters will need to be staged within the facility for at least several days to several months.

e. To get a rough idea of the number of filter sets multiply aircraft width by height to get a conservative cross-sectional area and multiply by 50 to get a rough order of magnitude for the air flow cfm. Divide by 150 feet per minute to arrive at the number of square feet of filter area. Divide by 4 sf to get a rough count on the number of filter sets; then divide by the planned stacking density (approx. 3-4 high). Multiply the number of stacks by 2 sf/stack to arrive at the space needed for storing filters, plus allow 100sf for accessibility to deliver and retrieve the filter boxes.

f. Generally, you cannot stack boxes more than 3 - 4 high.

16. Heating System

a. This is space for hot water boilers and steam boilers (for humidification). If direct or indirect fired burners are used within the air handling units, the AHU space should already properly account for that space.

b. As with the electrical room, the size of this equipment (and the room area) are proportional to the hangar floor space.

c. Generally, this room must be isolated with a fire-rated wall separate from all other functions. To account for this, include a base 200sf requirement.

d. Note: this space is sized on the presumption that the coat must cure in 8 hours, which requires a higher temperature and humidity than the application of the coating. If a longer cure time is acceptable, this space can be reduced by 25% or more.

e. Use 1.33% of hangar bay floor area to size this room.

f. <u>(Hangar Floor Area) * 0.0133 + 200sf</u>

17. Process Cooling

a. Note: the cooling equipment is considered required when its purpose is to meet bioenvironmental (heat stress) and paint application requirements.

b. The space is proportional to the hangar dock area.

c. For depot-level (paint/depaint) operations, consideration should be given to the addition of one spare chiller (or space for an additional chiller) which may be required to fulfill the mission of the facility. For Corrosion Control Facilities, the space may not be needed at all. But, if needed, reduce by 25% to account for not needing the spare chiller.

d. To account for pumps, air separators, and access around equipment, include a standard 300 sf.

e. Use 4% of hangar dock floor area to size this room.

f. (Hangar Floor Area) * 0.04 + 300sf

18. Special Allocation
    a. If the combined space for heating and cooling exceeds 4000sf, include an additional 1000sf to account for greater accessibility needs. This will ensure that all pieces of equipment can be replaced at the end of their useful life.

19 Administrative Spaces
    a. For depot-level (paint/depaint) hangars, a new, compliant, efficient, facility tends to draw additional administrative requirements (e.g., second level supervisors).

    b. See other sections of this UFC for the list of administrative spaces. Spaces such as conference rooms, Fax/Copier rooms [ASHRAE Indoor Air Quality Standards generally require a separate room for fax/copiers/printers] T.O. Library Room are fixed generally regardless of the population. To account for all spaces, use a standard 250sf.

    c. Otherwise, admin space can be calculated on a per-person basis without regard to rank/supervisory level.

    d. To account for gross square feet, use 120sf/person.

    e. (# of Admin/Supervisory persons) * 120 + 250sf

20. Break Area
    a This area should be as far from any contamination sources as possible and must be large enough to support the largest number of workers (aircraft and admin) expected. OSHA is paying very close attention to workers being provided the space to eat away from their work.

    b. A standard break area should include space for sinks, counters, microwaves (as many as one for every 10 workers), refrigerators (some organizations are now using commercial refrigerators that may be as large as 3'x6', and may have more than one), vending machines (for space purposes, assume 3 vending machines), ice machine, trash/recycling receptacles, or other storage unit. To account for these items, include a standard 500sf.

    c. The remaining space is for tables, chairs and circulation. The general guidance is to estimate 15sf/person.

    d. (Total Number of Workers in the Facility) * 15 + 500sf

21. Sprinkler Risers
    a. Usually, these are located in other spaces, but this ensures that the required space is considered in the total gross area.

b. Generally, assume one riser per 15,000sf of the otherwise total area.

c. <u>(Entire Calculated Area) / 15,000 * 50sf/riser</u>

22. Fire Pump Room
    a. Most hangars will need fire pumps because of the fire protection water demand, unless the installation has a separate water distribution system designed to support the fire protection systems in the hangars

    . b. <u>Use a standard 1000sf</u>.

23. Blast Media Unload/Storage
    a. Blast media is subject to two primary issues. First, the blast media is broken down by the blast operation and a certain amount of makeup media is needed. Second, it is possible to contaminate a full batch of media in a way that requires replacement of the entire batch.

    b. The quantity of blast media is very dependent on the specific operation and size of aircraft. Depaint hangars may need sufficient media on-hand to completely replace a contaminated batch. For a large aircraft, this could be 50 - 100,000lbs. For a corrosion control operation, it may be only necessary to have a two- to four-week supply based on normal depletion rates.

    c. Material is frequently delivered in 500-lb “super-sacks”. These are usually delivered on a 4x4 pallet so each super-sack will need about 20sf of space.

    d. Delivery paths for forklifts and normal circulation will add a standard 500sf.

    e. <u>(Weight of Media Stored) * 0.04 + 500sf</u>

24. Blast Media Recovery and Feed
    a. Blast Media is recovered using at least three and sometimes four processing steps. These include magnetic separation of iron particles, cyclone separation of media that has become too fine to be useful.

    b. The equipment is fairly large, so even a small operation should allocate 2000sf as a minimum standard area.

    c. The equipment size is, as above, dependent on what the user intends to use the system for. For depaint hangars, assume that the system must hold sufficient clean media for a full strip. In this way, even if the recovery system should fail, one complete aircraft could be stripped.

    d. <u>(Total Weight of Media to Strip one aircraft) * 0.04 + 2000sf</u>

25. Issue Room/Pharmacy

a. Most aircraft operations involve some amount of aircraft preparation (masking, replacement of sealants, small tools and parts, coveralls) In addition, it may be necessary to dispense solvents from an open container, which requires a separate, rated, room. This space covers these items. If the user has a list of material, it is relatively simple to calculate the shelving needed and, from that, the total space.

b. However, since that may not be available, for ease of calculation, use the number of workers per shift.

c. To account for workers assigned to the issue room/pharmacy and basics (desks, issue window, standard circulation), use a standard 500sf.

d. Use 30sf/worker.

e. <u>(Total number of workers per shift) * 30 + 500sf</u>

B-3 PERSONNEL SAFETY ISSUES.

B-3.1 Respiratory Protection.

29 CFR 1910.134(d), *Respiratory Protection*, specifies requirements for respiratory protection. Consult with an industrial hygienist or occupational health specialist to determine the appropriate type of respiratory protection required for each process.

B-4 MAINTENANCE CONTRACTS.

B-4.1 Service Contracts.

The process HVAC system for an ACCPF represents the most significant and critical function essential to fulfill the mission of an aircraft corrosion control facility. Today's controls are designed to operate automatically to maintain proper temperature, humidity, air velocity, hangar bay static pressure with numerous interlocks to ensure personnel safety. The precision of the controls along with the absolute necessity of high performance from the mechanical systems puts the process HVAC systems of an ACCPF into the category of demanding rigorous and specialized preventative maintenance on a regular basis. Because of the uniqueness and complexity of the equipment, these systems generally fall outside of the normal maintenance capabilities. It is therefore recommended that this preventative maintenance function be delegated to a company (or companies) who specialize in such systems on a regular basis through an annual service contract. Consider an annual service contract during the planning phase of a new Project.

The recommended annual tasks to be performed on the system at a minimum would include verification of control functions, test and balance and calibration of all air and water system temperatures and flow volumes. This work would be completed most efficiently in two parts, during the winter season for the heating system, and then in late spring, prior to the summer season for the cooling system. This work must be accomplished in addition to any other mechanical preventative maintenance (belt adjustment/ replacement, filter changes, greased bearings) that is normally performed on the mechanical equipment.

B-5 LESSONS LEARNED

The purpose of this section is to highlight selected lessons learned during the design, construction, and operation of corrosion control facilities that have been previously built. These lessons can be a good tool for guidance in the design of new and renovated facilities. By not repeating these mistakes, we hope to be able to design better facilities that will meet the needs of the users, state, local, and federal regulatory agencies. Eliminating the need for modifications to new or renovated facilities could potentially save millions of dollars.

The following are lessons learned from existing Air Force corrosion control facilities.

B-5.1 Dimensions of Booth/Bay.

Ensure that all dimensions of the largest aircraft to utilize the facility are taken into consideration during the design phase of the booth. The measurements must include adequate additional space for maintenance stands and work areas.

B-5.2 Incorporating Fall Protection Control Measures.

If fall hazards cannot be eliminated, fall protection and prevention measures must be incorporated or installed in all corrosion control facilities to ensure the safety of all personnel while working on the aircraft. If fall protection are incorporated into the design phase of the project, it will eliminate the need for added cost in rework to later install the system. Attached safety harnesses will allow for proper complete aircraft paints and eliminate the need to paint portions of aircraft outdoors or in unauthorized hangars. AFOSHSTD 91-100, *Aircraft Flight Line – Ground Operations and Activities*, paragraph 8.2.5 states that *“Whenever it becomes necessary to perform required tasks where a worker can fall 4 feet or more, fall protection will be used.”* See AFOSHSTD 91-501*,* Air Force Consolidated Occupational Safety Standard*,* for more information on fall protection equipment. EM 385-1-1, Section 5 and Section 21, addresses fall protection requirements.

B-5.3 Proper Sizing of Air Compressors.

Research what size compressor will be needed to accommodate all facility requirements based on all workers using tools simultaneously. It is also important to ensure that the building is wired to accommodate the proper size compressor.

B-5.4 Equipment Designation.

For some services and installations, it may make a difference if special equipment is designated as real property. This designation may effect which parties can accomplish repairs and routine maintenance. It may be beneficial to coordinate equipment purchase with the local installation support offices to ensure support for maintenance and repairs. Also, it is highly recommended that a maintenance contract with the manufacturer be considered.

B-5.5 Airflow Requirements

The objective of an optimum airflow design in a spray paint environment must be to achieve a linear near laminar air flow pattern. 29 CFR 1910.107 (b)(5)(i) states, "*The spraying operations except electrostatic spraying operations shall be so designed, installed and maintained that the average air velocity over the open face of the booth (or booth cross section during spraying operations) shall be not less than 100 linear feet per minute. Electrostatic spraying operations may be conducted with an air velocity over the open face of the booth of not less than 60 linear feet per minute, or more, depending on the volume of the finishing material being applied and its flammability and explosion characteristics. Visible gauges or audible alarm or pressure-activated devices shall be installed to indicate or insure that the required air velocity is maintained. Filter rolls shall be inspected to insure proper replacement of filter media.*"

B-5.6 Air Exhaust

Do not locate exhaust ports below the hangar air intakes, or in any configuration to create a potential for contaminated air to be recirculated through the facility. This may increase the solvent concentrations above the lower LEL limits creating a potential fire hazard. AFOSH Standard 161-2, *Industrial Ventilation*, paragraph 2.b. (6), notes that "*the air supply intake or process exhaust must be located to prevent contaminates being brought back into the facility*." 29 CFR 1910.107 (d)(9) states, "*Air exhaust from spray operations shall not be directed so that it will contaminate makeup air being introduced into the spraying area or other ventilation intakes, nor directed so as to create a nuisance. Air exhausted from spray operations shall not be recirculated*."

B-5.7 Electrical Equipment in Spraying Area

29 CFR 1910.107 (c)(5) states, "*Unless specifically approved for locations containing both deposits of readily ignitable residue and explosive vapors, there shall be no electrical equipment in any spraying area, whereon deposits of combustible residues may readily accumulate, except wiring in rigid conduit or in boxes or fittings containing no taps, splices, or terminal connections.*"

B-5.8 Pressure Differential Devices

Ensure the exhaust ventilation systems for the main aircraft hangar have a pressure differential manometer and/or other devices to ensure the system is operating as designed. 29 CFR 1910.107 (b)(5)(i) states, "*The spraying operations except electrostatic spraying operations shall be so designed, installed and maintained that the average air velocity over the open face of the booth (or booth cross section during spraying operations) shall be not less than 100 linear feet per minute. Electrostatic spraying operations may be conducted with an air velocity over the open face of the booth of not less than 60 linear feet per minute, or more, depending on the volume of* *the finishing material being applied and its flammability and explosion characteristics. Visible gauges or audible alarm or pressure-activated devices shall be installed to indicate or insure that the required air velocity is maintained. Filter rolls shall be inspected to insure proper replacement of filter media*."

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APPENDIX C APPLICABLE ENVIRONMENTAL STANDARDS

C-1 FEDERAL.

Many different federal environmental standards and regulations significantly impact the design of a Corrosion Control Facility. This vast array of requirements exceeds the scope of this guide and will not be covered in significant detail. For more information of environmental standards and regulations, contact your local environmental engineer and bioenvironmental office. During the planning stage of the corrosion facility, planners will complete a General Conformity applicability analysis before completion of the Environmental Impact Analysis Process (EIAP) to allow incorporation of its information into the EIAP. Federal actions must conform to the approved State Implementation Plan (SIP) until the State modifies the SIP or EPA approves the SIP.

C-1.1 Clean Air Act.

The Clean Air Act (CAA) is the major Federal statute (EPA 40 CFR Chapter I) governing the quality of ambient air and permitting releases to the air. There are several programs in the CAA that may have significant impacts or restrictions on the corrosion facility. One main way that the air quality is assured is the new source review (NSR) program. NSR program requires operators of certain types of air pollution-emitting facilities to apply for permission to build in certain areas to prove that the air will not result in worse air quality. These new major sources must not upset the established national ambient air quality standards (NAAQS) and may be required to implement Best Available Control Technology (BACT) to reduce hazardous air pollutants (HAPs) to Lowest Achievable Emission Rates (LAER). There are three types of permits issued under the NSR Program. The permits are Prevention of Significant Deterioration (PSD), nonattainment area NSR, and minor source NSR. The permit is based basically on the threshold values of regulated pollutants.

The National Emission Standards for Hazardous Air Pollutants for Source Categories: Aerospace Manufacturing and Rework Facilities (commonly called the Aerospace NESHAP) EPA 40 CFR Parts 9 & 63 must be applied as applicable in the design of Corrosion Control and Paint Finishing Facilities. This EPA standard applies to facilities that are a “major source” of hazardous air pollutants (HAP) and are involved in the manufacture or rework of commercial, civil, or military aerospace vehicles. (A “major source” of HAPs is defined as a facility or group of aerospace facilities within a contiguous area that emits or has the potential to emit 10 tons per year or more of any listed HAP or 25 tons per year or more of any combination of listed HAP) The local Environmental Management function will use many references, such as a NESHAP flow chart (Figure C-1) to determine if the proposed facility has the potential to be designated as a major source. This important determination will provide key information on whether or not Aerospace NESHAP requirements will apply to the facility, and will have very significant bearing on many design requirements for the facility.

It is important to note that many bases have elected to comply with NESHAP requirements even if they are not currently legally required to do so. Although the decision to voluntarily elect to comply with NESHAP requirements might initially lead to expensive facility design requirements, it ensures the facility will already be NESHAP compliant if circumstances change at the base and the facility is required to comply with NESHAP requirements at a later date. Reference the National Environmental Policy Act Compliance Guide.

Control of Volatile Organic Compounds.

EPA provides Control Technique Guidelines that States may incorporate into their rules limiting volatile organic compounds for non-major sources of Hazardous Air Pollutants. Reference EPA-453/R-97-004, *Control of Volatile Organic Compound Emissions from Coating Operations at Aerospace Manufacturing and Rework*.

C-1.2 Clean Water Act.

The Clean Water Act (CWA) is the primary Federal statute (EPA 40 CFR Chapter I) governing the quality of the Nation's water. It prohibits the discharge of any pollutant into navigable waters without a permit. Review the National Pollutant Discharge Elimination System Permits (NPDES) permits, the installation of the Spill Prevention, Control and Countermeasures (SPCC) and related documents pertaining to water quality. Also, remember that the Storm Water Pollution Prevention Plan (SWPPP) may need to be reviewed or updated. If the construction disturbs one or more acres, a completed SWPPP and submission of Notice of Intent (NOI) must be timely.

Wastewater discharges from Federally Owned Treatment Works (FOTWs) that is a point source into waters of United States require a NPDES permit. Discharges to Publicly Owned Treatment Works (POTWs) are considered as secondary discharges and are regulated by the POTW authority. POTW authority may have applicable regulations, permits, and agreements.

C-1.3 Resource Conservation and Recovery Act.

The Resource Conservation and Recovery Act (RCRA) is the broadest and widest waste law [40 CFR Chapter I, Subchapter I]. It manages waste included in a variety of other Federal statues such as Toxic Substances Control Act (TSCA), Used Oil Recycling Act, CAA, CWA, and Occupational Safety and Health Act. RCRA regulates solid waste (SW) and hazardous waste (HW) under the concept known as "cradle to grave". Many routine aircraft maintenance operations produce HW because of RCRA's definition. The hazardous waste management plan (HWMP) covers issues such as training, characterization, accumulation, treatment, recycling, inspections, and disposal of HW. One area that might be overlooked is industrial wastewater. Governmental regulations may prohibit discharging such wastewater into domestic wastewater or other non-industrial sewer systems. Pretreatment may not be practical also resulting in the wastewater to be managed under RCRA.

The bulk of what has to be done as RCRA is actually found in the Hazardous and Solid Waste Amendment (HSWA) that was pasted in 1984. Care must be taken with RCRA regulations found in EPA 40 CFR Chapter I, Subchapter I, Parts 260-281. In some activities, the generator can become the transporter or the treatment, storage, and disposal (TSD) facility based on HW duties and activities. This can have a major impact on training and the HWMP. Be sure to coordinate with local environmental engineers and bioenvironmental personnel for complete RCRA understanding.

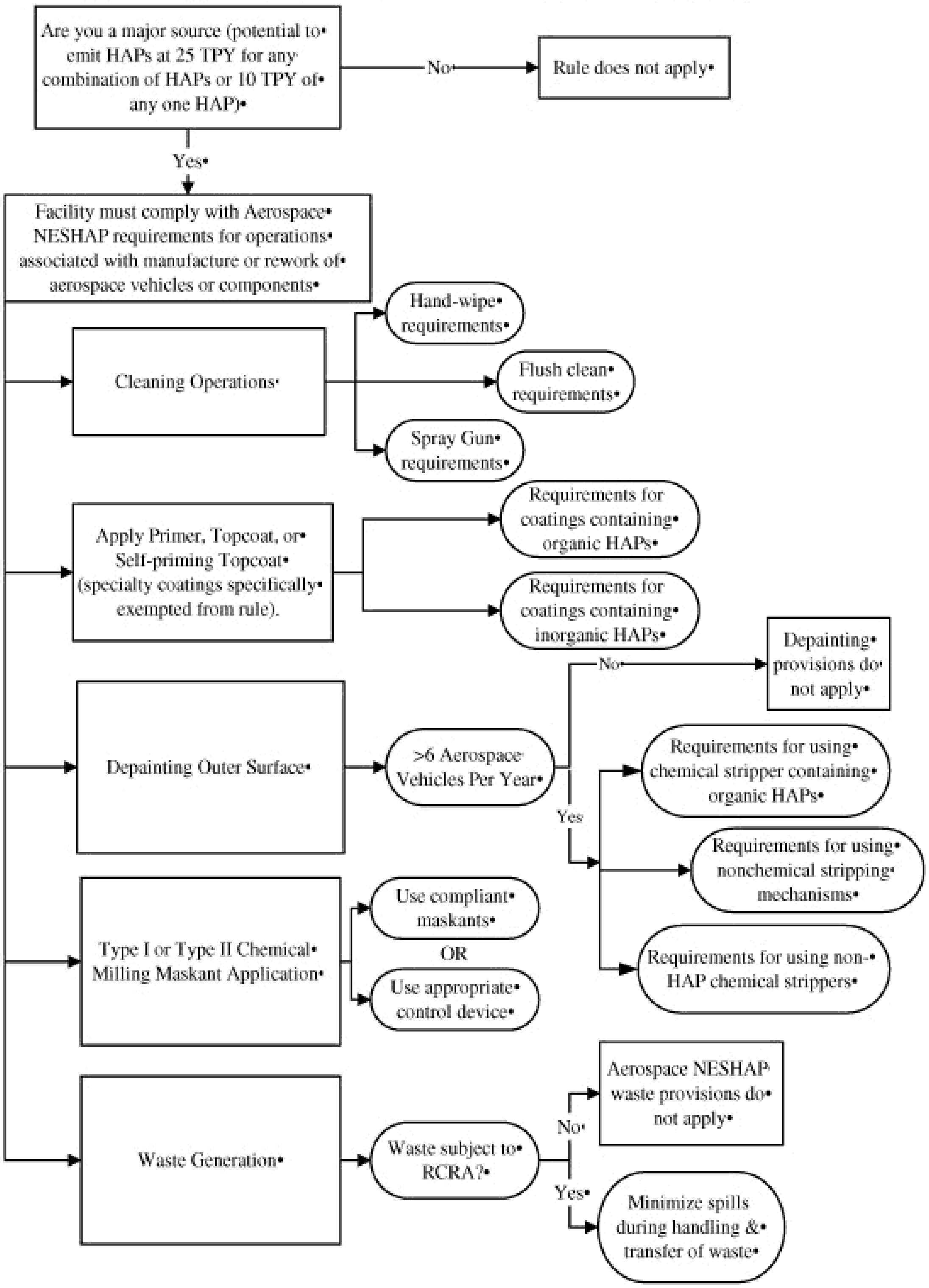
C-2 STATE.

In addition to meeting various federal laws, regulations and standards, the facility will also be required to comply with many different requirements mandated by the state the facility is located. Unfortunately, individual state environmental programs sometimes vary greatly. Therefore, it is important for local base agencies assisting in the design process to have access to the most current information. This type of information that is specific to each state can be found at the following website: http://www.rmis.com/db/lawepa.htm.

C-3 LOCAL.

More focus is being placed on the impact of local regulations through the Public Owned Treatment Works (POTW). Local systems are under tighter demands for drinking water, water usage, and sewer treatment. Industry programs many times focus only on the end-of-pipe solutions, which only handles wastewater pollutants. Yet, facilities that work with local regulators can help reduce pollution and waste cost. Ensure that local regulations are reviewed to prevent construction delays and reduce potential construction retrofits.

Figure C-1 Application of Aerospace NESHAP to Various Operations



APPENDIX D OSHA INTERPRETATIONS AND REFERENCES FOR REDUCED AIRFLOW AND RECIRCULATING AIRFLOW

This appendix is included as an aid to the designer for information regarding OSHA requirements for both reduced airflow velocity in the painting zone and allowance of recirculation of exhaust air when proper measures are taken for corrosion control hangars. The U.S. Air Force, which bears the largest share of corrosion control expenses for its fleets of aircraft, have taken a pro-active approach in these matters. Refer to Appendix B, page, B-4, of AFRL-ML-TY-TP-2004-4518, for a detailed analysis, response and requirements of the OSHA interpretations and supporting calculations for the recirculating model. The following is the Abstract from that publication-

"*The text of 29 CFR 1910.107(d)(9), which was imported from the 1969 revision of a fire safety standard, prohibits recirculating ventilation in spray painting facilities. Devices to measure vapor concentrations obsolete this standard almost immediately, but efforts to amend this statement have been frustrated. To accommodate advances in technology, OSHA invoked the designation "de minimis violation" to enable the use of recirculation and other technologies that comply with the most current consensus standards applicable to their operations . . . when the employer's action provides equal or greater employee protection. Whereas industry has adapted to this expedient, Department of Defense agencies have consistently interpreted that if 107(d)(9) is still in print and the alternative is called a violation, however qualified, military installations will not be given permission to employ exhaust recirculation (ER). Individual bases working in isolation have built a few examples of painting hangars using ER, but each of these facilities suffered from one or more serious design faults. Robins Air Force Base (RAFB), near Macon, Georgia, is acquiring a painting hangar to accommodate painting of C-5 aircraft in an ER ventilation system. Because the economics of exhausting 2.5 million cfm of temperature-controlled air is untenable, critical justification for using ER is provided by RAFB's environmental conditions, which require cooling and dehumidifying air used in the ventilation process during four to five months each year. This report identifies documentary precedents for competent designs of future paint facilities and describes the preparation and issuance of a design-and-build contract for construction of this new facility at RAFB*."

…Consistent with the interpretations12, 14, and 16 above, OSHA inspectors did not cite L3 or Air Force facilities using ER ventilation to paint aircraft at Seymour Johnson Air Force Base (SJAFB), N.C., and at Mountain Home AFB (MHAFB), Idaho. SJAFB's facility design placed a vapor control system inside the ER loop, lowering17 both total emissions and the increase in exposure within the workplace. The concept earned a 1994 award by EPA for environmental excellence and has profound implications17 for source reduction strategies."

The OSHA database for available information and interpretations edited as follows:

"*Laws, Regulations and Interpretations provides a comprehensive and easy to use resource for current OSHA standards and enforcement-related information.*

Interpretations, enforcement guides, and other enforcement related information will be interlinked with regulatory requirements using hypertext links. Not all interpretations which have been issued by OSHA are included on "Laws, Regulations and Interpretations page". Ongoing maintenance is designed to provide the most up-to-date OSHA standards and interpretations of employee safety and health issues, while reducing the duplication of information and removing outdated guidance."

Attached is a list of known interpretations attempting to clarify the use of reduced and recirculating airflow by OSHA. Included in the interpretations are those annotated with an "*" are no longer available from the database but are included for supporting clarification, establishing the track record of acceptance by OSHA in industry for various allowances over the last 15-20 years. A copy is included at the end of this appendix or through imbedded file links. Interpretations published on the website may be accessed directly by imbedded hyperlink.(Control-enter key on the subject)

Clarification subject	29 CFR 1910.107
Spray Booth vs. Spray Area	11/04/1976 - Clarification Paint Spray Booth and Spray Areas http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=18571
Recirculation Airflow Allowed	*10/16/1987- A Clarification of requirements for recirculating air discharged from Spray Operations
Recirculation Airflow Allowed	*11/03/1989- Exhaust Air in Spray Operations
Recirculation Airflow Allowed and interpretations of de minimis violations policy	*Jan 16, 1990- From Directorate of Compliance Programs
Recirculation Airflow and the allowance of most concurrent census standards and de minimis violations	*08/27/9991-Spray Booth compliance with OSHA standards is determined at the workplace
De minimis violation Impact/Lack thereof	1995 - 08/03/1995 - Letter requesting a compliance determination of control device system used primarily in paint spray booth applications.
Reduced velocity in paint spray areas	1997 - 04/08/1997 - The airflow rate required for a spray painting area.
OSHA De minimis policy and compliance to NFPA-33 which allows recirculation	1996 - 03/15/1996 - Spray Finishing.
OSHA De minimis policy and compliance to NFPA-33 which allows recirculation	1996 - 05/14/1996 - Interpretation for questions related to compliance with NFPA 33 (1995 edition).
Corrosion Control Hangars treated as spray areas per OSHA because of larger volumes allowing reduced airflows with de minimis policy	1-JUL-1999 INDUSTRIAL VENTILATION RATES IN AIRCRAFT CORROSION CONTROL HANGARS (See Figure D-2) of this document)
Reduced Air Velocities Allowed in Spray booths	2001 - 10/22/2001 - Clarification of minimum face velocity requirements for spray booths.
Recirculation in compliance with NFPA 33, considered a de minimis violation and would not be cited. One of the main standards now	2001 - 09/17/2001 - Full compliance with NFPA 33-2000 may be considered a de minimis violation.

cited by the U.S. Air force for corrosion control hangars considered as Spray areas.	
(80%) Recirculated air and 20% fresh air) to protect employees in a spray booth from air contaminants. (This is basically the same interpretation the Air force is fully adopting) . One of the main standards now cited by the U.S. Air force for corrosion control hangars considered as Spray areas	2002 - 06/24/2002 - Hierarchy of controls for exposure to air contaminants.
Spray Booth Compliance	2004 - 08/12/2004 - Spray booth requirements including automatic sprinkler systems, relationship to NFPA 33 requirements, and paint storage.
	1910.94
Reduction of Airflow velocities in Paint Booths	2001 - 10/22/2001 - Clarification of minimum face velocity requirements for spray booths.
Reduction of Airflow velocities in Paint Booths	1997 - 04/08/1997 - The airflow rate required for a spray painting area.

LETTERS RELATED TO AIRFLOW REQUIREMENTS FOR CORROSION CONTROL HANGARS

The following Figure D-1 contains the NFESC Memorandum (less enclosures 1, 2, 3 and 4) requesting OSHA to interpret the ventilation rates for aircraft corrosion control hangars. This Appendix also contains OSHA's response to NFESC's request - See Figure D-2.

Figure D-1. NFESC Memorandum to OSHA

DATE: May 13, 1999

MEMORANDUM

To: Ron Cain, Office of Federal Agency Programs, Occupational Safety and Health Administration, Washington, DC 20210

Via: John Plummer, Director, Office of Federal Agency Programs, Occupational Safety and Health Administration, Washington, DC 20210

From: Kathleen M. Paulson, P.E.
Naval Facilities Engineering Service Center
Naval Occupational Safety and Health - Air (ESC 425),
1100 23rd Avenue
Port Hueneme, CA 93043-4370
Commercial:(805) 982-4984, DSN: 551-4984, FAX:(805) 982-1409
Internet: paulsonkm@nfesc.navy.mil
Web Page: http://www.nfesc.navy.mil/enviro/esc425/NoshArBr.htm

SUBJ: INDUSTRIAL VENTILATION FLOW RATES IN AIRCRAFT HANGARS

We appreciate your offer to revisit the OSHA standard interpretation you provided to the Department of the Navy, Office if the Assistant Secretary, (Installations and Environment) regarding spray painting in aircraft hangars. See Enclosures (1) and (2). When we tried to apply the interpretation that you provided to us dated April 8, 1997, we discovered discrepancies in our characterization of the processes performed in Navy Final Finish and Corrosion Control Hangars. Enclosure (3) defines the operations performed in each of the various level hangars.

Our questions are:

1. What is your definition of a production spray finishing operation?
2. How do you characterize the five operational levels of hangars discussed in Enclosure 3?
3. What airflow rate criteria is required for each of the five levels?
4. If 100 cubic feet per minute per square foot of cross-sectional area is required for any of the five operational levels, please define the term cross-sectional area. Is it:

    a) Area of the exhaust filter bank?
    b) Area of the exhaust filter bank?
    c) Air envelope around the plane, which excludes the "empty" area where there will be no aircraft parts?
    d) Full opening of the hangar, for instance the approximate side of the hangar door opening plus about 5 feet on the top and sides of the hangar reserved for maneuverability?
    e) Full opening of the hangar including open space for roof trusses?

Naval Facilities Engineering Command (NAVFAC) assigned the NAVOSH Air Branch of NFESC to revise Military Handbook 1003/17, Industrial Ventilation Systems. The handbook defines engineering design criteria for use by all components of the Department of Defense. We are adding a new chapter to the MIL-HDBK discussing the criteria for spray painting in aircraft hangars. We are having difficulties applying the interpretation to our criteria. To add to the urgency, NAVFAC is also in the process of designing several new aircraft hangars. Reducing the flow rate from 100 cubic feet per minute per square foot of cross-sectional area will provide a significant reduction in equipment first costs and annual operating costs.

Our position is - Aircraft hangars should not be designed for 100 cubic feet per minute per square foot of cross-sectional area due to the size of the space and the dilution effect. Regardless of the flow rate, not all the paint overspray will reach the filters and we acknowledge some will drop to the floor. This is particularly true for the portion of the aircraft farthest from the exhaust filter bank. Paint spray criteria in the ACGIH Industrial Ventilation Manual permits airflow in large spaces as low as 50 cubic feet per minute per square foot of cross-sectional area. Both the NFPA 33 and the ANSI Z9.3 consensus standards require a sufficient ventilation rate to prevent vapor build-up by requiring airflow to keep the vapor less than 25% of the LEL. Airflow calculations based on LEL are typically 10-25% of the rates required for health protection. Enclosure (4) reiterates our understanding of the pertinent regulations.

Our experience shows that even in spray painting operations using flow rates of 100 cubic feet per minute per square foot of cross-sectional area, some employee's occupational exposure exceeds the PEL for certain paints and paint components. Therefore, our employees use respiratory protection when painting in hangars.

Thank you for continuing to consider our concern. Based on our phone conversation today, I understand that you are also working on this issue with the US Air Force. Could you direct us to their point of contact? Our contacts are Kappy Paulson and Trinh Do (805) 982-4984.

Figure D-2. OSHA interpretation.

U.S. Department of Labor

Occupational Safety and Health Administration
Washington, D.C. 20210

Reply to the Attention of:

JUL 1 1999

MEMORANDUM FOR: KATHLEEN M. PAULSON, P.E.
NAVOSH Air Branch
Naval Facilities Engineering Service Center

FROM: RICHARD PAIRFAX, Director
Directorate of Compliance Programs

SUBJECT: NFESC e-mail dated May 13, 1999

This memorandum is in response to your email of May 13, 1999 and confirms subsequent e-mail correspondence between you and Ron Cain of my staff.

OSHA considers the Department of Defense corrosion control hangars described in the NFESC memo dated May 13, 1999 as "spray areas." As such, the spray areas must comply with the requirements of NFPA 33, 1995 edition for "Spray Application Using Flammable or Combustible Materials," and with subpart Z of 29 CFR 1910 for hazardous substances. Non-compliance with table G-10 in 29 CFR 1910.94 will be considered *de minimis* by OSHA as long as the above requirements are met.

Should you require further assistance in this or any other matter, feel free to contact John Plummer or Ron Cain of my staff at 202-693-2122.

NOTE: De Minimis Violations. De minimis violations are violations of standards that have no direct or immediate relationship to safety or health. Whenever de minimis conditions are found during an inspection, they must be documented in the same way as any other violation but would not be included on the citation.

APPENDIX E GLOSSARY

3M	Maintenance and Material Management
ACCPF	Aircraft Corrosion Control and Paint Facilities
ACGIH	American Conference of Governmental Industrial Hygienists
AF	Air Force
AFCEE	Air Force Center for Engineering and the Environment
AFCESA	Air Force Civil Engineer Support Agency
AFCPCO	Air Force Corrosion Prevention and Control Office
AFFF	Aqueous film-forming foam
AFI	Air Force Instruction
AFIT	Air Force Institute of Technology,
AFM	Air Force Manual
AFRL	Air Force Research Laboratory
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
ATFP	Anti-terrorism/Force Protection
C	celsius
CCF	Corrosion Control Facilities
CATV	Cable Television
CCTV	Closed Circuit Television
CFD	Computational Fluid Dynamics
CFR	Code of Federal Regulations
CMU	Concrete Masonry Unit

cm	centimeter(s)
CONUS	Continental United States
dBA	decibels A weighted Scale
deg	degrees
DF	Depot Facilities
DMB	Dry Media Blast
DoD	Department of Defense
DODCE	Department of Defense Corrosion Exchange
DOE	Department of Energy
EIA	Electronic Industries Alliance
EM	Engineering Manual
EPA	U.S. Environmental Protection Agency
ETL	Engineering Technical Letter
FSP	Floor Supported Platform
F	fahrenheit
ft	feet
FC	Foot Candle
FP	Fire Protection
GPM	Gallons per minute
GSE	Ground Service Equipment
HAP	Hazardous Air Pollutants
HEF	High Expansion Foam
HVLP	High Volume Low Pressure
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HR	Humidity Ratio

HLL	Horizontal Life line
HVAC	Heating, Ventilation and Air Conditioning
HW	Hot Water
IBC	International Building Code
IESNA	Illuminating Engineering Society of North America
in	inches
IW	Industrial Waste
IWTF	Industrial Waste Treatment Facility
kPA	kiloPascals
kVA	kilovolt-amperes
LCC	Life Cycle Cost
LCCA	Life Cycle Cost Analysis
m	meter(s)
mm	millimeter(s)
max	maximum
min	minimum
MEH	Median of Exterme Highs
MEL	Media of Exterme Lows
MERV	Minimum Efficiency Reporting Value
MSDS	Material Safety Data Sheets
NADEP	Naval Aviation Depot
NAVFAC	Naval Facilities Engineering Command
NC	Noise Criteria
NESHAP	National Emission Standards for Aerospace Manufacturing and Rework Facilities
NFPA	National Fire Protection Association

NIOSH	The National Institute for Occupational Safety and Health
OCONUS	Outside the Continental United States
O/I	Organizational and Intermediate
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
PF	Paint Facilities
PFAS	Personal Fall Arrest System
PMB	Plastic Media Blasting
PPE	Personal Protective Equipment
psi	pounds per square inch
PVDF	Polyvinylidene fluoride
RH	Relative Humidity
SDI	Steel Door Institute
STC	Sound Transmission Class
TMP	Telescoping Man Lift Platform
UFC	Unified Facilities Criteria
V	Volt
VDC	Volts Direct Current
VFD	Variable Frequency Drive
VOC	Volatile organic compounds