

Base Facility Standard

Wright-Patterson AFB, Ohio



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1.0 INTRODUCTION

1.1 Purpose and Scope

The purpose of this document is to provide technical guidance for the more typical aspects of architectural/engineering design services. Architects and Engineers are to utilize the information in this guide in the development of construction contract documents and Design-Build Request for Proposals (RFP) and serve as the minimum architectural requirements. Project conditions may dictate the need for design that exceeds these requirements.

1.1.1 Applicability

This document applies to agencies of the U.S. Armed Services and their contractors that are preparing construction contract documents for projects on Wright-Patterson Air Force Base (WPAFB). This document applies to construction types regardless of funding, including properties listed or eligible for listing on the National Register of Historic Places, as well as National Guard and Reserve projects constructed on this installation. Certain specialized facilities, such as health care facilities, carry more stringent requirements. See the Unified Facilities Criteria (UFC) or other criteria that are applicable to the respective specialized facility that is being designed. This document is applicable to the traditional architectural/engineering services customary for Design-Bid-Build design services and for Design-Build construction contracts.

1.1.2 Document Improvements and Deviations

This is to be considered a "Living Document." Recommended changes, additions, and requests for deviation are invited from anyone who uses it. Recommended changes, additions, additional guidance topics and requests to deviate from this document are accepted at any time. Recommendations can be offered electronically or in paper form, forwarded to [REDACTED].

1.2 General Description of WPAFB

WPAFB is located adjacent to the city of Dayton, Ohio, commonly known as "the birthplace of aviation." With over 700 facilities and 1,636 housing units (100 government-owned and 1,536 privatized), the 33 square kilometers (8,145 acre) Base has the character of a small city with its own residential, office, industrial, recreational, retail, health care, and educational uses. As diverse as its tenant organizations, the Base population of approximately 22,000 people is made up of civilian and military personnel, military dependents, contractors, students, and transient military personnel.

The complexity of WPAFB is compounded by its physical layout. The Base is divided into two distinct areas - Area A and Area B. Area B is separated from Area A by State Route 444:

- Area A, which primarily houses administrative functions, contains the Headquarters for the Air Force Materiel Command (HQ AFMC), National Air & Space Intelligence Center (NASIC), the Wright-Patterson Medical Center, and several military housing areas. Area A also encompasses the only active airfield on Base and houses the headquarters for the 88th Air Base Wing, the Kittyhawk Community Center, military family housing areas, and several morale, welfare, and recreation facilities.
- Area B, which is principally comprised of research, development and education functions, contains the Life Cycle Management Center (LCMC), Wright Laboratory, the Air Force Institute of Technology (AFIT), and the National Museum of the United States Air Force.

1.3 General Points of Contact - Base Level

- Base Civil Engineering POC for Anti-Terrorism/Force Protection (AT/FP):
 - [REDACTED]
- Architectural Review Committee (ARC):
 - [REDACTED]
 - [REDACTED]
 - [REDACTED]
- Base Communications: [REDACTED]
- Base Community Planners:
 - [REDACTED]
 - [REDACTED]
- Base Energy Management: [REDACTED]
- Base Facility Standard Editor: [REDACTED]
- Comprehensive Interior Design: [REDACTED]
- Electric Utility Privatization: [REDACTED]
- Environmental Management: [REDACTED]
- Fire Prevention: [REDACTED]
- Fire Protection Specialist – Alarm/Detection Systems:
 - [REDACTED]
 - [REDACTED]

- Fire Protection Specialist – Sprinkler Systems: [REDACTED]
- Historic Preservation: [REDACTED]
- Industrial Control Systems (ICS):
 - [REDACTED]
 - [REDACTED]
- Information Protection – Physical Security (Classified Facility Construction):
 - [REDACTED]
 - [REDACTED]
- Mechanical HVAC & Plumbing Engineer: [REDACTED]
- Mechanical Infrastructure Engineer: [REDACTED]
- Pavement/Airfield Pavement Engineer: [REDACTED]
- Record Drawings: [REDACTED]
- Structural Engineer: [REDACTED]
- Traffic Engineer: [REDACTED]
- Water/Sanitary/Waste Treatment Engineer: [REDACTED]

Note: Telephone numbers are in area code 937

1.3.1 Coordination with Government Personnel

Requests for necessary technical information from the above mentioned sources, or other Base level source, shall be coordinated through the Base Civil Engineering Design Manager (DM) for each project. Maintain direct communication with the DM. This may avoid unnecessary re-submittal of plans and specifications due to a misunderstood comment. The reviewer's name, phone number and/or email address can be found on the comment sheets. The project manager will provide comments regarding corrections or clarifications to be incorporated into contract documents or other design submittals. Ensure that design comments are incorporated into the subsequent submittal or thoroughly describe the reason for not incorporating the comment. The Architect-Engineer (A/E) is responsible for the resolution and incorporation of government

comments into the project design. Contact the DM to discuss comments that will not be incorporated, for whatever reason.

1.4 Record Drawings

The A/E shall have access to the Base Civil Engineering record drawings in order to perform required research and investigation of existing as-built drawings. The A/E shall be responsible to field verify as-built drawings as the Government does not guarantee their accuracy. Base Civil Engineering does not have the supplies to provide in-house reproduction capability. The A/E shall either provide paper supplies for the required copies or arrange to have drawings reproduced by an outside vendor. WPAFB will send images to the A/E's printing company for reproduction. Reproduction of drawings shall be at the A/E's expense.

2.0 STANDARD DESIGN REFERENCES AND CRITERIA

2.1 Codes and Publications

The A/E shall prepare design documents in conformance with the applicable portions of the latest editions of the following codes and publications:

- UFC 1-200-01; Design: General Building Requirements
- UFC 1-200-02; High Performance and Sustainable Building Requirements
- UFC 3-310-04; Seismic Design for Buildings
- UFC 3-600-01; Fire Protection Engineering for Facilities
- UFC 4-010-01; DOD Minimum Antiterrorism Standards for Buildings
- UFC 4-010-05; Sensitive Compartmented Information Facilities Planning, Design, and Construction
- DODM 5200.1; Volume 3, DOD Information Security Program
- AFI 31-401; Information Security Program Management
- AFI 91-203; Air Force Consolidated Occupational Safety Instruction
- Area B Downtown Exterior Architectural Development Plan
- Architectural Barriers Act Accessibility Standards (ABA); Chapters 1 through 10
- Installation Restoration Program Drawings
- Intelligence Community Directive (ICD) 705; Sensitive Compartmented Information Facilities
- International Building Code (IBC)
- JAFAN 6/9; Physical Security Standards for Special Access Programs
- Mil/Hdbk 1013/1A; Design Guidelines for Physical Security of Facilities
- National Fire Protection Association (NFPA) Codes
- Life Safety Code
- Ohio Manual on Uniform Traffic Control Devices (Ohio MUTCD)
- OSHA 29-CFR 1910, 1926
- Preserving a Heritage: Standards and Illustrated Guidelines for Rehabilitating Historic Air Force Buildings and Structures. Office of the Civil Engineer, US Air Force, 1996
- WPAFB Instruction 21-1001; Sign Management

The A/E shall also use other Unified Facilities Criteria (UFC), Air Force publications, and Engineering Technical Letters (ETL's) as applicable to the specific project. Additional publications are listed in each section of this standard.

In the case of conflicts between the IBC and other military criteria, use the military criteria.

2.1.1 Obtaining Publications

The A/E shall be responsible for obtaining required publications. Most publications are available on the internet.

2.2 Code Analysis

The A/E shall be responsible to complete, and document as part of the concept (10%) design analysis, a comprehensive code analysis for each assigned project. The analysis shall include applicable local, state, national, and Air Force codes and clearly indicate structural, fire, safety, etc. requirements and deficiencies

2.2.1 Code Deficiencies

The DM shall review the code deficiencies identified by the A/E in the 10% design submittal and the original project scope with the appropriate government offices/individuals and determine if a change in scope is warranted.

2.2.2 Code Summary Sheet

The A/E shall be responsible to provide a comprehensive summary of specific code references pertaining to the assigned project including, at a minimum the International Building Code (IBC) as modified by UFC 1-200-01 and NFPA 101 Life Safety Code. The code summary shall be included as part of the 35% design drawings, and subsequent design submittals, located immediately after or incorporated into the project title sheet. The code summary shall include, at a minimum, a building/site plan clearly indicating appropriate pertinent information from the WPAFB Fire Protection/Life Safety Code Review Form, as well as a detailed written analysis.

2.3 Field Investigation of As-builts

2.3.1 For Design-Bid-Build and Design-Build, the A/E shall obtain site and building data and investigate existing site conditions, utilities, and facilities as necessary to properly integrate the design of the project with existing conditions. Except as otherwise contracted, field investigations shall include complete and accurate site investigation, topographic/hydrographic survey, hydrant flow and pressure tests, and verification of location and availability of utility and drainage systems. The A/E shall have access to the Base Civil Engineering record drawings in order to perform required research and investigation of existing as-built drawings. Existing as-built record drawings are available as described in paragraph 1.4; the A/E shall be responsible for field verification of as-built drawings and other site features that may influence project design. The Designer of Record shall be responsible to verify site information given by the Government issued RFP.

2.3.2 For Design-Bid-Build and Design-Build, the Designer of Record shall provide additional field investigations and verification of existing site conditions as may be required to support the development of the design and construction of the project.

2.4 Specifications

Prepare construction project technical specifications using SpecsIntact (free software available from <http://specsintact.ksc.nasa.gov/>) to edit Unified Facility Guide Specifications (UFGS). Download current UFGS master sections (MasterFormat 2004) from <http://specsintact.ksc.nasa.gov/masters/masters.htm> and edit accordingly for each construction project. Completed and preliminary submittal project specifications shall be submitted in a **single** PDF file. Each project specification shall have a title page and table of contents. Insert the specification section number and page number in the footer of each specification page. Insert the construction project title at the top left and the construction project number at the top right of the header of each specification page. Insert the submittal register after Section 01 33 00 (01330). For design submittals prior to the 100% final submittal, “revisions” shall be turned on so deletions and additions to each specification section are clearly visible. When processing and compiling specifications, configure SpecsIntact to include the project table of contents without scope and to bookmark sections in the combined PDF file and add the section number to the section bookmark.

UFGS that have been unified for use by participating agencies have a level 3 or level 4 MasterFormat™ number. UFGS that are agency-specific have a fifth level number indicating it as an agency specific specification. A specification that has a fifth level number "10" indicates USACE, a "20" indicates NAVFAC, a "30" indicates AFCESA and a "40" indicates NASA. Preparing agencies are indicated in the UFGS header of each specification. Users of UFGS should first consider a unified UFGS if one is available, next a UFGS identified as specific to their agency and, and lastly a UFGS identified as specific to another agency.

See files in Appendix C for specific UFGS editing notes.

Obtain current WPAFB master specification sections from the DM and insert into the construction project technical specifications as required for each project. WPAFB master specification sections will be provided in SpecsIntact .sec format only. Every project must include sections 01 01 00, 01 01 50, 01 02 20, and 01 33 00. WPAFB master specifications include the following:

01 01 00*	SUMMARY (WPAFB)
01 01 50*	PROJECT GENERAL REQUIREMENTS (WPAFB)
01 02 20*	GENERAL ENVIRONMENTAL PROTECTION REQUIREMENTS (WPAFB)
01 04 10	AIRFIELD PROJECT REQUIREMENTS (WPAFB)
01 04 20	HOUSING PROJECT REQUIREMENTS (WPAFB)
01 33 00*	SUBMITTAL PROCEDURES (WPAFB)
02 08 10	REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS (WPAFB)
02 08 30	REMOVAL OF PCB AND PCB-CONTAMINATED TRANSFORMERS AND OTHER PCB ITEMS (WPAFB)
02 08 31	REMOVAL OF PCB AND PCB-CONTAMINATED ITEMS AND LIQUIDS (WPAFB)
02 08 32	TRANSPORTATION AND DISPOSAL OF PCB AND PCB-CONTAMINATED WASTES (WPAFB)
02 08 33	REMOVAL OF POLYCHLORINATED BIPHENYL FLUORESCENT LIGHT BALLASTS (WPAFB)
02 08 34	REMOVAL OF MERCURY-CONTAINING LAMPS (WPAFB)
02 08 40	PCB SPILL CLEANUP AND SITE RESTORATION (WPAFB)
02 08 50	REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS ON UNDERGROUND UTILITY LINES (WPAFB)

02 09 00	REMOVAL AND DISPOSAL OF PAINT CONTAINING LEAD MATERIAL (OSHA COMPLIANCE) (WPAFB)
02 09 01	REMOVAL AND DISPOSAL OF PAINT CONTAINING LEAD MATERIAL (HUD AND OSHA COMPLIANCE) (WPAFB)
02 09 10	OZONE DEPLETING SUBSTANCE RECOVERY (WPAFB)
22 00 01	BACKFLOW PREVENTION DEVICES (WPAFB)
23 09 23	DIRECT DIGITAL CONTROLS FOR HVAC (WPAFB)
26 13 00	SULPHUR HEXAFLUORIDE (SF-6) INSULATED SWITCHES (WPAFB)
31 21 13	RADON MITIGATION (WPAFB)

*Mandatory for every project

2.4.1 Proprietary Specifications

Do not use proprietary or restrictive requirements unless it is conclusively established that no substitute will serve the purpose. When a situation arises in which only a single product will perform the required function, forward a request to the DM, fully justifying the use of a sole source product. In addition to the detailed justification, provide an estimate of the proprietary item in relation to the total project contract cost. Use of proprietary items is prohibited unless formal written approval is obtained from a Contracting Officer.

If authorization is granted, specify the proprietary item by manufacturer's name and catalog number, followed by the phrase: "notwithstanding other provision of the contract, no other product will be acceptable." The statement is necessary to override the contract clause that permits substitution of supposedly equal products unless such language is used.

Specification sections that contain proprietary items must include a notice to that effect on the first page of the section. Place the following above the section number and title at the top of the first page of the section: "This Specification Contains Proprietary Products."

2.4.2 "Or Equal" Specifications

Specifying products by naming acceptable commercial products followed by the words "or equal" is permitted. However, in each instance, include in the description a minimum of two acceptable manufacturers and list the salient physical, functional, or performance characteristics that will satisfy the Government's needs.

2.4.3 Experience Clauses

Ordinarily, experience clauses are not included in the technical specifications. On occasion, because of special difficulties in the work, strict construction schedules, or past unsuccessful experience with contractors, an experience clause may be used to ensure competence in the contractor. Experience clauses relate to the responsibility of a firm, and more specifically, to its capacity to perform the work. The inclusion of experience clauses in project specifications requires the approval of a Contracting Officer. Experience clauses that occur in the UFGS have been reviewed by a Contracting Officer

and may be used without further approval or waiver. When adding an experience clause to the UFGS, obtain approval of a Contracting Officer.

2.4.4 Warranty Clauses

Ordinarily, warranty clauses are not included in specifications. A warranty clause is a provision that modifies terms of the normal 1-year warranty required by the contract clause. There are two classes of exceptions:

- First, it is acceptable to extend the period of the warranty based on the judgment of the A/E, if the industry routinely provides such extended periods of warranty and the unusually complex nature of the product makes the provision cost effective on a life-cycle basis, or if UFGS suggest the extension.
- Second, it is possible to add terms to a warranty, but only in the rarest of circumstances and with written approval of a Contracting Officer or when UFGS indicate such an extension has been reviewed and approved by a Contracting Officer.

2.5 CADD Standards

WPAFB CADD standards are included in Appendix A, file “Appendix A_CADD STANDARDS.docx”.

2.6 DD Form 1354 Requirement

Designer shall provide a completed Draft DD Form 1354 for all designed construction projects. Design documents shall include the requirement that contractors shall complete and submit Final DD Form 1354 for all construction projects.

2.7 BUILDER Updating

Design documents shall include the requirement that contractors shall complete and submit BUILDER Update Form for all construction projects.

2.8 Lay Down Area Requirement

A specified lay down area to store project materials and equipment for the duration of a construction project shall be provided as part of the Design Drawings. The lay down area shall be sufficiently sized to accommodate trailers, construction materials, and equipment traffic. The lay down area shall be located within a reasonable proximity to the project area to minimally impact roads, and utility tie-ins shall be taking into consideration. A minimum 6ft tall chain-link

fence with privacy fabric shall be provided along its perimeter in prominent areas to create a privacy screen from the surrounding context.

3.0 ARCHITECTURAL

3.1 Introduction

In accordance with the goals of the AFMC Facility Quality Program, this section was developed to ensure consistency in future design and construction projects. This section is not intended to stifle creativity, nor does it advocate "cookbook" architecture, it simply communicates and illustrates current design standards that will unify and strengthen the architectural fabric of WPAFB and the ASC.

3.1.1 Design Excellence

Excellence in design is a primary goal for WPAFB projects. Reaching this goal requires a commitment by the Government and A/E to quality that includes the relationship of architecture and land use to the surrounding community, as well as to the details of design that affect the users of buildings and facilities. Quality architectural design vitally improves facility operating efficiency, sustainability, attractiveness, livability, life cycle economics, and ultimately the productivity of the users.

3.1.2 Design for Flexibility

Flexibility in architectural design facilitates the change or expansion of an existing structure to accommodate changing functional requirements with minimum expenditure of resources. The U.S. military usually owns and operates its facilities from their time of construction until the end of their useful life. During this long tenure of use, functional requirements of buildings will change, often drastically. Design facilities to accommodate change in use with a minimum expenditure of resources. Careful planning for reconfigurable technology infrastructure and utility distribution, minimizing permanent interior walls and using systems furniture and demountable partition systems enhances flexibility. For this reason, flexibility is a significant design requirement for buildings, except for those with highly specialized functions where adaptive reuse would be cost prohibitive. When feasible, facilities shall be designed to facilitate future expansion in response to mission requirements.

3.1.3 Architectural Review Committee

88 CEG has established an Architectural Review Committee (ARC) in accordance with the goals and directives of the AFMC Facility Quality Program. The ARC shall provide design guidance, enforce the intent of this Base Facility Standard (BFS) and insure architectural compatibility that will unify and strengthen the architectural fabric of WPAFB promoting a vision of design excellence.

3.2 Architectural Districts

For purposes of this standard, WPAFB has been divided into thirteen Architectural Districts that identify specific areas of this Base where compatibility with adjacent facilities shall be stressed. Some architectural issues, such as paint and signage, do not vary from district to district and become unifying elements in the Base master plan. The thirteen Architectural Districts are summarized below.

3.2.1 District 1 - Wright Field

This district includes the National Museum of the United States Air Force, its runway area, and the associated clearance areas. The primary architectural form is expressed in the large metal arch structures used by the museum for the display of aircraft.

3.2.2 District 2 - The Prairies and the Woods at Wright Field

This district consists of single-family, garden homes and townhouses, and community facilities.

3.2.3 District 3 - Area B Downtown

This district includes the historic research area, the historic WWII flight line area, and the future development of the ASC complex. The older area is dominated by brick industrial structures while the newer administrative buildings are predominately precast concrete.

3.2.4 District 4 - Area B - East

This district is a combination of research facilities, the Air Force Institute of Technology (AFIT) educational facilities, and industrial/utility facilities of varied age and style.

3.2.5 District 5 - Not Used

3.2.6 District 6 - Command/Administrative Area

This district includes the AFMC Headquarters, National Air and Space Intelligence Center (NASIC) Headquarters, communication and industrial facilities. Future construction should follow the architectural design established by the AFMC and NASIC facilities which range from simple to embellished concrete structures.

3.2.7 District 7 - Brick Quarters Housing and the Medical Center

This WPA constructed brick Tudor style residential area has been established as a historic district. It includes the Wright-Patterson Club & Banquet Facility and other associated recreational facilities, as well as the Temporary Living Facilities (TLF). The Medical Center is not part of the historic area but has its own separate architectural style.

3.2.8 District 8 - Base Administrative/Industrial Area

This area includes most of the Base warehouses, base headquarters, civil engineering administration, and other Base administrative facilities. Red brick and sloped roofs dominate this area that also includes some metal and precast structures.

3.2.9 District 9 - Kittyhawk

This district includes most of the community service and commercial facilities including the Base Exchange, Commissary, dormitories, and other recreational facilities.

3.2.10 District 10 - East Flight Line

The south side of this district includes aircraft hangars and maintenance facilities associated with aircraft. The north side includes air cargo facilities, POL and other flight line related facilities. Most structures in this area are metal hangars or similar support facilities.

3.2.11 District 11 - West Ramp

This district is used by the 445th Reserve Squadron and includes hangars, aircraft maintenance shops and administrative areas for the squadron. Most structures in this area are metal hangars or similar support facilities.

3.2.12 District 12 - Bass Lake and Munitions Storage Area

Included are the recreational facilities along Bass Lake and the igloos and other munitions storage facilities. The structure style here is predominately rustic or buried.

3.2.13 District 13 - Floodplain District

This includes the area along the Mad River, Huffman Prairie Flying Field and Huffman Prairie area, and recreational areas including Twin Lakes and the civilian golf course. The architectural style is rustic or simple utility buildings.

3.3 Historic Preservation

WPAFB and HQ AFMC are dedicated to complying with Federal legislation pertaining to the preservation of historic facilities. Careful coordination between WPAFB and the State Historic Preservation Office (SHPO) is essential. The historic significance of buildings at WPAFB is based on the following federal criteria:

- Usually more than 50 years old and still relatively intact and
- Associated with a significant person; or
- Associated with a significant event; or

- Characteristic of an architectural style or time period; or
- Capable of yielding data significant to the Nation
- Associated with the Cold War era for facilities less than 50 years old

Facilities meeting these criteria are potential candidates for the National Register of Historic Places. At WPAFB, candidate facilities are identified by the Base Cultural Resources Manager (CRM) and approved by the State Historic Preservation Office (SHPO).

There are over 260 examples of WPAFB facilities/structures that are eligible for the National Register of Historic Places. These include three historic districts identified as representative of distinct eras of Base and/or Air Force history. Contact the CRM for the current list of historic facilities at WPAFB.

3.3.1 Base Cultural Resources Management Office

Environmental Assets Section (88 CEG/CEIEA) is responsible for assigning an individual to coordinate historic preservation issues with the historic preservation regulatory agencies, 88 CEG, and appropriate using agencies. The WPAFB CRM is:

88 CEG/CEIEA
Mr. Paul Woodruff
1450 Littrell Road
Wright-Patterson AFB OH 45433-5209
257-1374

3.3.2 State Historic Preservation Office (SHPO)

Through delegation of federal authority, the State Historic Preservation Office (SHPO) is responsible for surveying and recognizing historic properties, reviewing nominations for properties to be included in the National Register of Historic Places, reviewing undertakings for the impact on the properties as well as supporting federal organizations, state and local governments, and private sector. The SHPO also works with the Base to arrive at a consensus list of facilities eligible for the National Register of Historic Places.

3.3.3 Monitoring Historic Facilities

Historically significant facilities are monitored by the CRM and SHPO. Repair/renovation or addition work is checked against standard procedures and in most cases work proceeds, occasionally with modification. The objective of this process is that historic facilities are kept active and protected, while maintaining their historic significance.

Design documents for projects having the potential to impact significant facilities must be sent to the CRM for transmittal to the SHPO for approval. Government funds must not be committed to a project to perform work on a historic property until the SHPO coordination process has been completed and approval from the CRM has been given.

After receipt of project documents, SHPO has thirty days to concur in these proposed projects or offer comments as to how to better minimize or avoid adverse impacts. Projects having potential adverse impacts may also need to be coordinated with the federal Advisory Council on Historic Preservation.

3.4 Sustainable Design

UFC 1-200-02, High Performance and Sustainable Building requirements, guides compliance with the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, Executive Orders 13423 and 13514, the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings (HPSB), and DOD and USAF sustainable design and development guidance. The WPAFB project team and A/E shall review the UFC and ensure applicable requirements are incorporated into construction contract documents.

As described in the Air Force sustainable design and development guidance, certain projects require registration and formal certification in the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) Rating System

Regardless of the extent to which UFC 1-200-02 and LEED apply to a given project, Air Force policy is to reduce the total ownership costs, including life-cycle costs of facilities, by incorporating sustainable development principles and strategies in the planning, programming, design, construction, operation and maintenance, sustainment, restoration and modernization of facilities and infrastructure projects to the fullest extent possible, consistent with mission, budget and client requirements. Consult the Whole Building Design Guide "Federal High Performance and Sustainable Buildings" section for technical guidance.

3.5 Handicapped Accessibility

WPAFB is dedicated to providing adequate handicapped accessibility in facilities Base-wide. Accessibility issues shall conform to the codes and guidance provided by the Architectural Barriers Act Accessibility Standards (ABA), Chapters 1 through 10.

3.5.1 Maintenance and Repair

If existing elements, spaces, essential features, or common areas are altered, then each such altered element, space, feature, or area shall comply with the applicable provisions of the ABA standards. The path of travel to these primary functions must meet the same standards.

Facilities that are eligible for listing in the National Register of Historic Places shall comply with ABA standards, using methods consistent with the Standards and Illustrated Guidelines for Rehabilitating Historic Air Force Buildings and Structures.

3.5.2 Military Exclusions

As a goal, WPAFB will strive to provide adequate accessibility to facilities regardless of the military exclusions granted by the Uniformed Federal Accessibility Standards in section 4.1.4.

3.6 Base Comprehensive Planning

3.6.1 Base Comprehensive Plan (BCP)

Careful and proper planning is critical to successful architectural compatibility at WPAFB. The BCP for WPAFB provides the installation with a framework to guide programming, design, and construction of facilities at the Base in support of existing and future missions. The A/E firms shall refer to the BCP for information affecting each construction project.

3.6.2 Facility Siting

Proper facility siting in accordance with the Wright-Patterson Land Use Plan (Component Plan D of the BCP) is essential to avoid incompatible land usage. As chairman of the Team Wright-Patt Council, the 88 ABW/CC shall approve siting requests for new construction.

3.6.3 Siting Considerations

Prior to design, construction projects are reviewed by the Base Community Planner and the ARC specifically to determine the best acceptable site. Often a project is granted siting approval subject to a variety of conditions which must be adhered to in the design and construction of the project.

The site parameters vary with each project, including such issues as access, parking considerations, utility relocations, flood plain issues, noise proofing requirements, environmental concerns, and others. The A/E shall contact the Base Community Planner to determine the specific restrictions associated with each project site. Changes in the site location of a facility, even those minor in nature, must be coordinated with the Base Community Planner and the ARC.

3.6.4 Area Development Plans (ADP)

When proposed construction requires planning beyond the limits of a single facility, designers should pursue the creation of Area Development Plans in order to facilitate thoughtful planning of the relationship facilities have with one another.

3.6.5 Air Installation Compatibility Use Zone (AICUZ)

The WPAFB AICUZ study of 1995 provides an assessment of noise levels and statistical analysis to determine aircraft Accident Potential Zones (APZ). The goals of the study are to provide protection of the public and compatible development of the lands affected by Base flying operations.

For new construction or major renovation of facilities within the AICUZ noise contours, the A/E shall apply the appropriate level of sound attenuation as determined by Figure 4 of the AICUZ report. New construction must comply with the APZ recommendation in Figure 4 of the AICUZ report. Whenever feasible, major renovations of existing facilities shall also comply with these guidelines in an effort to reduce the population in the APZ.

3.6.6 WPAFB Airport Zoning Ordinance

WPAFB's relationship with the surrounding communities cannot be overlooked. As part of the Joint Land Use Study (JLUS) program, an airport zoning ordinance has been developed in which our AICUZ recommendations have been applied to local zoning and land use policies.

3.6.7 Housing Community Plan (HCP)

An HCP was completed for WPAFB in 1996. This report contains extensive information on both the whole house and the community improvement recommendations. An extensive database is included in the report that contains detailed information on each housing unit on the Base. For projects within the family housing area, this HCP report must be followed.

3.7 Architectural Finishes

Careful and consistent selection of construction materials and finishes is the most critical element of architectural compatibility. Color, texture, and pattern must be considered not only in the context of the building being designed, but also in the larger context of the site and neighboring buildings. Durability and low maintenance are also vital to a successful design (Refer to Section 3.18).

3.7.1 Paint Standards

New buildings constructed at WPAFB shall be designed to require no exterior painting and minimum maintenance. However, because this is an old Base, the need to regularly paint our stock of existing and historic buildings will be with us for the foreseeable future.

Use of semi-gloss, eggshell and other enamelized paint finishes shall be maximized. Use of flat paints shall be minimized.

Paints and coatings applied to exterior building surfaces, equipment and fixtures shall conform to the following palette:

- *Base Color* (defined as 70% +/- of surface area);
- *Accent Color* (defined as 10% +/- of surface area);
- *Trim Color* (defined as 20% +/- of surface area);
- *Historical Trim Color* (applied only within Brick Quarters Historic District).

Paint standards for WPAFB have been organized into a numbering system for coating systems. A Wright-Patterson color number is assigned to a corresponding paint manufacturer color number.

Paint Application	WPAFB Color Number
<i>Base Color</i>	WP-B1
<i>Accent Color</i>	WP-A2
<i>Trim Color</i>	WP-T3
<i>Historical Trim Color</i>	WP-H4 (Brick Quarters Historical District only)

Surfaces that are to receive a specific coating are to be finished in accordance with the WPAFB Paint Standards published herein. This requirement includes such items installed as part of a construction, infrastructure or utility project. Only WPAFB Color No.'s WP-B1, WP-A2, and WP-T3 are acceptable colors for painted or factory finished items. The ARC must approve deviations from these colors. Colors that have been selected for specific items of facility equipment and fixtures include, but are not limited to the following:

Equipment, Fixture or Accessory	WPAFB Color Number
<i>Infrastructure Items</i>	
Fire Hydrants	WP-T3
Tanks	WP-B1
Transformers, Switchgear, etc.	WP-T3
<i>Building Equipment</i>	
Louvers	WP-A2 or WP-T3
<i>Building Accessories</i>	
Recycle Bins/Dumpsters	WP-T3

Loading Dock Bollards, Safety Railings, & Other Safety Equipment not Regulated by OSHA or USAF Safety Regulations.

Select the Base, Accent, or Trim Color that will contrast with the adjacent background color.

Note: Avoid painting hand railings and guardrails (except previously painted items). Use unpainted galvanized (exterior), stainless steel or aluminum railings (interior). Aluminum with duranodic coatings and/or stainless steel posts, handrails, cable, and miscellaneous fittings (mixed metals only with proper corrosion prevented details) are to be specified in all locations unless exceptions such as remote locations from facilities and industrial sites are approved (galvanized may be acceptable at these locations). Do not use 'field painted' metals

WPAFB Paint Number	Paint Manufacturer Color Number	Paint Manufacturer Color Formula
WP-B1	Porter Guard Fast Dry Alkyd	Tint base #2749 B-2, C-26, L-5Y16, M-24
	Porter Acri-Pro 100 Flat	Tint base #929 18E, 10J, 1Y16K per gallon
WP-A2	Porter Guard Fast Dry Gloss	Tint base #2749 26B, 1Y28E, 1Y2J, 6YT
	Porter Acri-Pro Semi-Gloss	Tint base #6029 18B, 1YE, 6YT per gallon
WPAFB Paint Number	Paint Manufacturer Color Number	Paint Manufacturer Color Formula
WP-T3	Pittsburgh Paints Industrial Enamel Interior/Exterior Semi-Gloss	Tint base #7-377 B-35Y, C-18Y16, F-4Y8, W-15Y per 5-gallon
	Pittsburgh Paints Industrial Enamel Interior/Exterior Gloss	Tint base #7-817 B-7Y, C-3Y32, F-40, W-3Y per gallon

WP-H4 Consult your design manager and the ARC for proper paint and color selection for use in the Brick Quarters Historical District and other historic facilities if appropriate.

Note: **Formulas above are for matching color only!** The use of WPAFB color numbers allows each paint manufacturer an equal opportunity to formulate an approved color match for the type of coating selected. Examples shown above in gloss, semi-gloss or flat are not meant to specify type or use in any specific application. Submittals shall indicate type of coating specified with tint base and color to match those listed above.

The WPAFB Paint Standards are dynamic and open to interpretation based upon the circumstances. Contact the ARC for further guidance concerning the application of and deviations from the paint standards.

3.7.2 Fire Hydrants

All hydrant bonnets and cap colors shall be in accordance with NFPA 291 Fire Flow and Marking of Hydrants, based on flow capacity (at 20 psi residual pressure):

1. Class AA – Rated capacity of greater than 1500gpm (5680 L/min) – Light Blue
2. Class A – Rated Capacity if 1000 – 1499gpm (3785 – 5675 L/min) – Green
3. Class B – Rated capacity of 500 – 999gpm (1900 – 3780 L/min) – Orange
4. Class C – Rated capacity of less than 500gpm (1900 L/min) – Red

For rapid identification at night, the capacity colors should be of a reflective-type paint.

WPAFB Paint Number	Paint Manufacturer Color Number	Paint Manufacturer Color Formula
WP-H1	Pittsburgh Paints Safety Red 90-306	90-306
WP-H2	Pittsburgh Paints Safety Green 90-311	90-311
WP-H3	Pittsburgh Paints Safety Orange 90-313	90-313
WP-H4	Pittsburgh Paints Clearwater 90-375	90-375 D-21 ½, E-3Y, W 2Y32

3.7.3 Metal

Metal siding, roofing panels and fascia are used throughout the Base as architectural elements/finishes. Approved uses within the appropriate areas are based on a per case basis by the ARC.

The color of choice for standing seam metal roofing and metal siding panels is based upon the following manufacturer's standard products. The use of other manufacturer's products must be approved by the ARC.

BERRIDGE

Aged Metallic Colors – Zinc Grey

Metallic Colors – Zink Coat

Lead Coat

Pre-weathered Galvalume

Champagne

Weathered Metallic Colors – Medium Bronze

ATLAS

#20 – Slate Grey

#28 – Silversmith

#03 – Medium Bronze

DIMENSIONAL Metals, Inc. (DMI)

Slate Grey

Champagne

Metallic Silver

Spartan Bronze

ARMOR CLAD

Champagne

Silver

Seal Brown

Slate Grey

FIRESTONE UNA-CLAD

Medium Bronze

Silver Metallic

Champagne Met

Slate Grey

COLORKLAD

Musket Grey

3.7.4 Pre-Cast Concrete

Pre-cast concrete is an acceptable finish depending on site location, type of texture, finish, shape of panels, and color of mix. The ARC must approve elevations and material selections.

3.7.5 Architectural Concrete Masonry Units (CMU)

Exterior architectural units shall be fabricated with integral water repellant and shall be integrally colored during manufacture. Water repellant primer and stain shall also be applied to exterior architectural CMU walls after completion of exterior work and when the masonry is not subject to damage by construction activities. General purpose common, smooth face CMU is not acceptable for use as an exterior veneer or as facing units. The ARC must approve elevations, material and color selections.

Architectural CMU which will be exposed to weathering shall be tested for efflorescence. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Tests results shall be provided in the Design Analysis; units meeting the definition of “effloresced” will be subject to rejection.

3.7.6 Brick

A wide variety of color, sizes, shapes, bond elevations, and applications are used throughout the Base. Brick is the preferred material of choice due to its aesthetic qualities and life cycle costing as related to project size. The ARC must approve elevations and material selections.

Comply with the Brick Industry Association technote 7, technote 18A, and technote 21B for specific brick masonry recommendations and other topic-specific technotes as applicable.

Comply with Brick Institute of America technote 21B for brick cavity/veneer wall design and construction.

Design components of the wall system to control moisture and to preclude water penetration of the barrier wall construction.

Indicate required flashing on the drawings. In order to direct moisture out of a cavity through weep holes, provide continuous flashing at the bottom of the cavity and wherever the cavity is interrupted by elements such as shelf angles or lintels and above an intersecting roof plane. Extend flashing through the outer masonry face and turn down to form a drip. Do not terminate through-wall flashing behind the exterior face. Install through-wall flashing over openings, sills, spandrels, shelf angles and parapets.

Use of clear masonry sealer to prevent water penetration is prohibited.

Plastic flashings are not allowed. Specify only superior quality flashing materials since repair or replacement of cavity flashing is exceedingly expensive. Do not use asphalt-impregnated felt flashing. Do not use aluminum flashing in brick construction. Through-wall flashing shall be bituminous membrane coated copper flashing, copper or stainless steel.

Antifreeze admixture compounds for cold weather freeze resistance are not allowed. Provide a tight (non-porous) face brick to reduce water absorption and to reduce freeze-thaw damage.

Provide a 1 inch clear dimension from the face of cavity insulation board or sheathing material to the back of the exterior wythe of masonry.

Provide open head joint weeps at through-wall flashing for brick masonry. Locate weeps on the same course as the flashing. Space weep holes at 24 inches on center for brick masonry and 32 inches for concrete masonry.

Brick which will be exposed to weathering shall be tested for efflorescence. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Tests results shall be provided in the Design Analysis; units meeting the definition of “effloresced” will be subject to rejection.

3.7.7 Mortar and Grout

Efflorescence testing of mortar shall be in accordance with ASTM C 67. Components causing efflorescence shall be rejected. The ARC must approve elevations, materials and color selections.

3.7.8 Exterior Insulation Finish Systems (EIFS)

Exterior insulation and finish systems (EIFS) have limitations, which make their use problematic. In special cases, where matching an existing facility’s exterior material, and when approved by the ARC, EIFS may be allowed. In those cases, do not install EIFS within six inches of grade or a stone or brick base shall be used to reduce damage/deterioration caused by exterior landscaping maintenance and mowing/trimming grounds keeping. Do not install EIFS in areas where it will be subject to abuse by moving vehicles or equipment, such as a loading dock. Do not use EIFS in areas of heavy pedestrian traffic, or if such use cannot be avoided, specify high-impact resistant system. Use high-impact systems a minimum of four feet above grade where subject to damage from pedestrian traffic or lawn maintenance equipment. Only self-draining and mechanically fastened EIFS systems will be considered. Integral colors must match Base standards. The ARC must approve elevations, materials and color selections.

3.7.9 Other Finishes

Uses of other systems and/or finishes will be decided on a case by case basis through the ARC.

3.8 Roofing

WPAFB has over 1.5 million square meters (15 million square feet) of roof areas. Of this total, approximately 0.8 million square meters (8.7 million square feet) is low-slope built-up roofing, with remainder being a variety of steep-sloped roofing systems.

3.8.1 Existing Roof Types

The majority of low-slope roofing systems consist of multi-ply felts with asphalt or coal tar bitumen, either gravel surfaced or coated on a variety of insulation types and structural decks. Other low-slope systems on Base include single ply rubber, modified bitumen and structural standing seam metal.

The remainder of steep-sloped roofing systems consists primarily of asphalt shingles plus a significant number of clay tile roofs, metal roofing systems and roll roofing. A small number of specialized systems are in use including floating tank cover roofs, geodesic domes, and earth-covered systems.

3.8.2 Slope Conversion Policy

Air Force policy promotes conversion of low-slope roofs to steep roof systems during the re-roofing process when economically feasible and aesthetically pleasing. The latest Air Force guidance for determining the feasibility of a particular roof for slope conversion is contained in the HQ USAF Policy Letter on Slope Conversions (Flat to Sloped) dated 13 May 1991.

Slope conversions typically involve superimposing a wood truss, plywood and shingle system over an existing low-slope structural system (residential solutions) or the erection of a light-gage metal substructure covered with structural standing seam metal. The latest Air Force guidance for standing seam metal roofing is contained in the HQ AFMC design and construction guidelines titled "Standing Seam Metal Roofing" dated 9 October 1985.

Standing seam metal roofs shall have a minimum 1/2:12 slope. Refer to Section 3.7.2.

3.8.3 Low-Slope Roof Systems

Built-up roof systems shall be designed in accordance with UFC 3-110-03 "*Roofing*" and AFI 32-1051 "*Roof Systems Management*", and should use the guide specification UFGS 07 51 13 "*Built-up Asphalt Roofing*".

New low-slope roofs shall have 1/2" per 1' slope minimum. New low-slope roofs shall have the slope built in the roof deck. They shall not utilize lightweight fill or tapered board insulation. Design snow guards on roof systems to preclude sudden falling of snow and ice.

Single-ply roof systems are considered non-conventional roofing systems and the HQ AFMC roof engineer must approve their use. Guidance for the request for approval is contained in the AFMC Policy on Non-Conventional Roofing System Approval and Acceptance into the Applications Engineering Program, dated 20 March 1990. If AFMC approval is given for a single ply rubber system, the Guide Specification contained in ETL 90-8 shall be followed.

3.8.4 Roof-Top Equipment

If at possible, placement of rooftop mechanical and utility equipment shall be avoided. However, if no other viable alternative exists, equipment must be curb mounted and secured against high winds. Do not use pitch pockets. Keep roof penetrations to an absolute minimum. Recommend use of sidewall louvers for air intake and exhaust. Mask equipment behind parapets, architecturally compatible screens/louvers, or set equipment in depressed center section of pitched roofs.

3.8.5 Roof Access

Control roof access in accordance with UFC 4-010-01, Minimum Antiterrorism Standards for Buildings. Buildings must have internal roof access through a manufactured roof access hatch. Arrange secure facilities so that roof access is from a mechanical room accessible only from the exterior, to limit uncleared personnel from passing through secured spaces.

3.8.6 Roof Drainage

A built-in gutter system where drainage passes through interior spaces or is concealed in the exterior wall cavity is prohibited.

3.8.7 Concrete Roof Decks

Do not use mechanical fasteners on concrete decks due to spalling potential, engagement problems, labor expense and future tear off expense and damage to decking. Use of lightweight insulating concrete, gypsum fill or asphaltic perlite fill materials is not recommended. Incorporate lightweight cellular concrete where deck fill material is deemed necessary.

3.8.8 Environmental Considerations

Due to prevalence of asbestos fibers in certain roofing materials, re-roofing projects must be sampled at an appropriate time in the design phase. Items typically sampled include

the membrane in the field of the roof, base flashing and roof coatings. Refer to Section 6.0 of this standard for further guidance.

Certain WPAFB facilities have been identified as historically significant. Early in the design phase, the CRM (88 CEG/CEIEA) should review the project to evaluate the impact of the re-roofing on historic structures. This evaluation is most critical on slope-conversion projects, when removal of historically significant elements is being proposed, or when alteration of the original roof color and texture is proposed. Refer to Section 6.7 of this standard for further guidance on historic preservation issues.

3.8.9 Color Selections

The ARC must approve color selections for shingles, standing seam metals, fascias, gutters, down spouts, flashing, and other exposed materials where a natural or manufactured color is applied. Refer to Section 3.7.

3.8.10 Roof Warranty

Roof warranty must be a minimum two year Contractor's warranty and extended roof covering manufacturer's warranty as outlined in UFC 3-110-03, Roofing.

3.9 Fenestration

Select window and glazing materials based on life cycle cost considerations, as well as human comfort considerations. Operable windows shall be provided for occupied facilities, unless not allowed by security considerations or specifically deleted by the customer and the project manager. Window type and glazing material must comply with UFC 4-010-01, DOD Minimum Antiterrorism Standards for Buildings. The ARC must approve window frame color and glass tint selections. Clearly indicate the type of window and glazing material on the contract documents.

3.10 Signage

Consistent, compatible signage throughout the Base can serve as an excellent tool to visually tie together various built and natural environments. Every effort must be made to reduce unnecessary or outdated signs that provide visual clutter and only serve to adversely affect architectural compatibility efforts on this Base.

3.10.1 Standard Exterior Facility Signs

Exterior facility signs at WPAFB are the sole responsibility of the 88 CEG Sign Shop. The WPAFB Sign Standards have been developed in accordance with UFC 3-120-01, *Air Force Sign Standard*, and the standards of the Zip+4 Program in Program Action Directive (PAD) 91-1:

- TYPE B1 - Facility Sign (upper echelon)
- TYPE B2- Facility Sign (lower echelon)
- TYPE B3 - Facility Sign (excluding street address)
- TYPE B4 - Building Entry Sign
- TYPE C1 - Centralized Facilities Sign
- TYPE C2 - Community Facility Sign
- TYPE D2 - Directional Sign

3.10.2 Facility Identification

With the approval of the ARC, standardized lettering will be allowed on the exterior of prominent facilities. The standard is Helvetica Medium, anodized bronze, cast aluminum letters, mounted flush, and sized accordingly. Signs applied to the facilities such as building number signage shall be furnished and installed in the construction contract.

3.10.3 Logos, Super Graphics and Commercial Advertising

Painted logos and racing stripes are not acceptable. The policy at WPAFB is to strive to reduce and/or eliminate existing super graphics and self-help organizational logos.

3.10.4 Interior Signage

Ensure necessary interior signage is incorporated as part of the architectural drawings. Accessible facilities must utilize signage that meets current ABA standards. Incorporate necessary signage schedules into the architectural drawings and specification sections and coordinate documents.

3.11 Landscaping

Landscape themes include planting treatments, site elements, barriers and screening, pedestrian environments, and open space; which contribute to the environmental and visual quality of WPAFB. Landscaping is a critical part of good building design, and plays a vital role blending architecture into its surroundings.

Low maintenance or maintenance free design around facilities is required. Ensure the landscaping provided does not interfere with overhead power lines when it reaches maturity, and is a sufficient distance (varies with spread of plant) away from underground utilities. The size of landscaping within the 33 ft unobstructed zone around buildings is restricted as per UFC 4-010-01.

Where site constraints allow trees other than small ornamental varieties use long-lived trees native to Southwest Ohio.

3.11.1 Approved Tree/Shrub Planting List

- Landscape plantings shall conform to the following list of WPAFB Recommended Plantings. Landscaping in historic districts must be coordinated with the CRM, 88 CEG/CEIEA.
- The following lists represent what species of trees are permitted to be planted on WPAFB, as well as species that are prohibited from being planted.
- Careful consideration should be given to each situation prior to selecting a species of tree. Location, site conditions, mature tree size, utility right-of-way clearances, fruit-bearing verses non-fruit bearing and future maintenance needs are some things that should be considered prior to specie selection.
- Landscaping plans must comply with ANSI A300, Part 5.
- All plant material must comply with American Standard for Nursery Stock ANSI Z60.1
- All trees must be planted in accordance with International Society of Arboriculture Specification 02950.
- 10-20-30 Species Diversity Rule must be adhered to which states: No more than 10% of the same species, 20% of the same genus or 30% of the same family of tree or shrub may be planted at any one site.
- No planting shall be made that cannot be maintained for a minimum of 1 year.
- All plantings shall carry a 1 year warranty from the time of planting.
- Contracts must specify that plantings must be maintained (watered) for a minimum of 1 year.
- Questions and/or comments concerning this list should be directed to the 88 CEG/CEIE Natural Resources Program Manager, 257-4857.

Approved Tree List

COMMON NAME	SCIENTIFIC NAME	HEIGHT	SPREAD	COMMENTS
Alder, European Black	<i>Alnus glutinosa</i>	45'-60'	15'-25'	
Arborvitae	<i>Thuja occidentalis</i>	20'-30'	6'-10'	
Aspen, Bigtooth	<i>Populus grandidentata</i>	45'-60'	20'-30'	
Aspen, Quaking	<i>Populus tremuloides</i>	40'-50'	15'-25'	
Baldcypress, Common	<i>Taxodium distichum</i>	40' – 60'	20' – 30'	
Basswood, American	<i>Tilia americana</i>	60' – 80'	35' – 40'	
Beech, American	<i>Fagus grandifolia</i>	70'-80'	60'-70'	
Beech, Blue	<i>Carpinus caroliniana</i>	20'-30'	10'-20'	
Birch, Black	<i>Betula lenta</i>	40'-50'	30'-40'	
Birch, River	<i>Betula nigra</i>	40'-50'	30'-40'	
Birch, Yellow	<i>Betula alleghaniensis</i>	60'-70'	40'-50'	
Buckeye, Ohio	<i>Aesculus glabra</i>	50'-60'	20'-30'	
Buckeye, Yellow	<i>Aesculus flava</i>	70'-80'	20'-30'	
Butternut	<i>Juglans cinerea</i>	50'-60'	40'-50'	
Catalpa, Northern	<i>Catalpa speciosa</i>	60'-70'	30'-40'	
Cedar, Eastern Red	<i>Juniperus virginiana</i>	20'-30'	10-15'	

Cherry, Black	<i>Prunus serotina</i>	50'-60'	40'-50'	
Chestnut, American	<i>Castanea dentata</i>	70'-80'	50'-60'	
Chestnut, Chinese	<i>Castanea mollissima</i>	40'-50'	40'-50'	
Coffeetree, Kentucky	<i>Gymnocladus dioicus</i>	70'-80'	40'-50'	
Cucumbertree	<i>Magnolia acuminata</i>	60'-70'	20'-30'	
Dogwood, Flowering	<i>Cornus florida</i>	15'-30'	20'-30'	
Dogwood, Silky	<i>Cornus amomum</i>	8'-10'	8'-10'	
Elderberry	<i>Sambucus Canadensis</i>	8' - 10'	10' - 12'	
Elm, American	<i>Ulmus americana</i>	50'-60'	70'-80'	
Elm, Slippery	<i>Ulmus rubra</i>	50'-60'	40'-50'	
Hackberry	<i>Celtis occidentalis</i>	50' - 75'	40' - 50'	
Hawthorn	<i>Crataegus species</i>	20'-30'	20'-30'	
Hawthorn, Washington	<i>Crataegus phaenopyrum</i>	15'-25'	10'-15'	
Hawthorn, Thornless Cockspur	<i>Crataegus crusgalli inermis</i>	20' - 30'	20' - 30'	Cultivar
Hawthorn, Thicket	<i>Crataegus punctata</i>	25' - 35'	25' - 35'	
Hazelnut	<i>Corylus americana</i>	10'-15'	10'-15'	
Hemlock, Eastern	<i>Tsuga canadensis</i>	60'-70'	25'-35'	
Hickory, Bitternut	<i>Carya cordiformis</i>	60'-70'	25'-35'	
Hickory, Shagbark	<i>Carya ovata</i>	60' - 80'	25' - 35'	
Hickory, Shellbark	<i>Carya laciniata</i>	35'-45'	50'-60'	
Hophornbeam, American	<i>Ostrya virginiana</i>	20'-30'	20'-30'	
Hornbeam, Upright European	<i>Carpinus betulus 'Fastigiata'</i>	30' - 40'	10' - 15'	Cultivar
Horsechestnut	<i>Aesculus hippocastanum</i>	50'-60'	50'-60'	
Larch, Eastern	<i>Larix laricina</i>	60'-70'	15'-25'	
Locust, Black	<i>Robinia pseudoacacia</i>	40'-50'	20'-30'	
Locust, Thornless Honey	<i>Gleditsia triacanthos inermis</i>	30' - 70'	30' - 50'	Cultivar
Maidenhair Tree	<i>Ginkgo biloba</i>	70'-80'	50'-60'	
Maple, Red	<i>Acer rubrum</i>	60'-70'	30'-40'	
Maple, Sugar	<i>Acer saccharum</i>	70'-80'	30'-40'	
Mulberry, Red	<i>Morus rubra</i>	40' - 70'	40' - 50'	
Oak, Black	<i>Quercus velutina</i>	30' - 60'	30' - 50'	
Oak, Bur	<i>Quercus macrocarpa</i>	80'-90'	70'-80'	
Oak, Chestnut	<i>Quercus prinus</i>	50'-60'	40'-50'	
Oak, Chinquapin	<i>Quercus muehlenbergii</i>	50'-60'	70'-80'	
Oak, English	<i>Quercus robur</i>	40'-50'	40'-50'	
Oak, Pin	<i>Quercus palustris</i>	60'-70'	30'-40'	
Oak, Red	<i>Quercus rubra</i>	60' - 75'	50' - 60'	
Oak, Sawtooth	<i>Quercus acutissima</i>	50'-60'	50'-60'	
Oak, Scarlet	<i>Quercus coccinea</i>	60'-70'	40'-50'	
Oak, Shingle	<i>Quercus imbricaria</i>	50'-60'	60'-70'	

Oak, Shumard	<i>Quercus shumardii</i>	50'-60'	30'-40'	
Oak, Swamp Chestnut	<i>Quercus michauxii</i>	60'-70'	30'-40'	
Oak, Swamp White	<i>Quercus bicolor</i>	50'-60'	50'-60'	
Oak, White	<i>Quercus alba</i>	50' – 80'	50' – 80'	
Osage-Orange	<i>Maclura pomifera</i>	30'-40'	30'-40'	
Pawpaw	<i>Asimina triloba</i>	20'-30'	10'-20'	
Persimmon	<i>Diospyros virginiana</i>	40'-50'	20'-30'	
Pine, Loblolly	<i>Pinus taeda</i>	40'-50'	20'-30'	
Pine, Pitchlolly	<i>Pinus rigida x taeda</i>	50'-60'	30'-40'	
Pine, Red	<i>Pinus resinosa</i>	40'-50'	20'-30'	
Pine, Scotch	<i>Pinus sylvestris</i>	40'-50'	20'-30'	
Pine, Virginia	<i>Pinus virginiana</i>	30'-40'	20'-30'	
Pine, White	<i>Pinus strobus</i>	70'-80'	30'-40'	
Plum, American	<i>Prunus americana</i>	15'-25'	15'-25'	
Redbud	<i>Cercis Canadensis</i>	20' – 30'	25' – 35'	
Rose, Rugosa	<i>Rosa rugosa</i>	20'-30'	8'-10'	
Sassafras	<i>Sassafras albidum</i>	40'-50'	20'-30'	
Serviceberry, Allegheny	<i>Amelanchier laevis</i>	20' – 25'	8' – 15'	
Serviceberry, Downy	<i>Amelanchier arborea</i>	15' – 25'	15' – 25'	
Serviceberry, Thicket	<i>Amelanchier canadensis</i>	10'-20'	10'-15'	
Spicebush	<i>Lindera benzoin</i>	10'-15'	10'15'	
Spruce, Colorado	<i>Picea pungens</i>	40'-50'	20'-30'	
Spruce, Norway	<i>Picea abies</i>	70'-80'	30'-40'	
Spruce, White	<i>Picea glauca</i>	50'-60'	15'-25'	
Sumac, Smooth	<i>Rhus glabra</i>	10'-20'	10'-20'	
Sweetgum	<i>Liquidambar styraciflua</i>	60' – 75'	40' – 50'	
Sycamore	<i>Platanus occidentalis</i>	70'-80'	50'-60'	
Tuliptree	<i>Liriodendron tulipifera</i>	70'-80'	30'-40'	
Tupelo, Black	<i>Nyssa sylvatica</i>	50'-60'	20'-30'	
Walnut, Black	<i>Juglans nigra</i>	60'-70'	60'-70'	
Willow, Black	<i>Salix nigra</i>	25'-35'	25'-35'	
Willow, Streamco	<i>Salix purpurea</i>	10'20'	10'-20'	
Zelkova, Japanese	<i>Zelkova serrata</i>	50' – 80'	40' – 60'	Non-Native

Deciduous Shrubs

COMMON NAME	SCIENTIFIC NAME	HEIGHT	SPREAD	
Black Chokeberry	<i>Aronia melanocarpa</i>	3' – 5'	3' – 5'	
Crimson Pygmy Barberry	<i>Berberis thunbergii</i> <i>atropurpurea</i> 'Crimson Pygmy'	2' – 3'	3' – 4'	
Buttonbush	<i>Cephalanthus occidentalis</i>	3' – 15'	4' – 8'	

American Filbert	<i>Corylus americana</i>	6' – 12'	8' – 12'	
Velvet Cloak Smokebush	<i>Cotinus coggygia</i> 'Velvet Cloak'	10' – 15'	8' – 12'	
Burning Bush	<i>Euonymus alatus</i> 'Compacta'	6' – 10'	4' – 6'	
Common Ninebark	<i>Physocarpus opulifolius</i>	5' – 10'	8' – 10'	
Potentilla	<i>Potentilla fruticosa</i>	1' – 4'	2' – 4'	
Fragrant Sumac	<i>Rhus aromatic</i>	2' – 4'	6' – 8'	
Carolina Rose	<i>Rosa Carolina</i>	3' – 6'	5' – 10'	
Snowmound Spirea	<i>Spirea nipponica</i> 'Snowmound'	3' – 5'	3' – 5'	
Common Snowberry	<i>Symphoricarpos albus</i>	3' – 6'	6' – 12'	
Dwarf Korean Lilac	<i>Syringa meyeri</i> (palibiniana)	4' – 8'	4' – 6'	
Lowbush Blueberry	<i>Vaccinium angustifolium</i>	1' – 2'	2' – 4'	
Mapleleaf Viburnum	<i>Viburnum acerifolium</i>	4' – 6'	4' – 6'	
Witherod Viburnum	<i>Viburnum cassinoides</i>	4' – 6'	4' – 6'	
Nannyberry Viburnum	<i>Viburnum lentago</i>	15' – 18'	10' – 12'	
Korean Boxwood	<i>Buxus microphylla korena</i>	3' – 4'	3' – 4'	
Wintergreen Korean Boxwood	<i>Buxus microphylla korena</i> 'Wintergreen'	2' – 3'	3' – 4'	
Blue Holly	<i>Ilex X meserveae</i> (Blue Cultivars)	4' – 5'	4' – 5'	
Common Juniper	<i>Juniperus communis</i>	5' – 10'	6' – 12'	
Weigela	<i>Weigela florida</i>	6' – 9'	8' – 10'	

Species Recommended in Special Cases & Under Optimum Conditions

COMMON NAME	SCIENTIFIC NAME	TYPE
European Beech	<i>Fagus sylvatica</i>	Deciduous Tree
Cotoneaster	<i>Cotoneaster sp.</i>	Deciduous Shrub
Linden, Littleleaf	<i>Tilia cordata</i>	Deciduous Tree
Oregon Grapeholly	<i>Mahonia aquifolium</i> 'Compactum'	Evergreen Shrub
Pine, Austrian	<i>Pinus nigra</i>	Evergreen Tree
Dwarf Alberta Spruce	<i>Picea glauca</i> 'Conica'	Evergreen Shrub

Species NOT to be Planted

COMMON NAME	SCIENTIFIC NAME	TYPE
Fir (All)	<i>Abies sp.</i>	Evergreen Tree
Ash (All)*	<i>Fraxinus sp.</i>	Deciduous Tree
Boxelder	<i>Acer negundo</i>	Deciduous Tree
Silver Maple	<i>Acer Saccharinum</i>	Deciduous Tree
Tree-of-Heaven**	<i>Ailanthus altissima</i>	Deciduous Tree
Japanese Barberry**	<i>Berberis thunbergii</i>	Deciduous Shrub

Crown-Vetch**	<i>Coronilla varia</i>	Deciduous Groundcover
Russian Olive**	<i>Elaeagnus angustifolia</i>	Deciduous Tree
Winged Euonymus**	<i>Euonymus alatus</i>	Deciduous Shrub
Wintercreeper**	<i>Euonymus fortunei</i>	Deciduous Groundcover
Privet (All)**	<i>Ligustrum sp.</i>	Deciduous Tree or Shrub
Honeysuckle (All)	<i>Lonicera sp.</i>	Deciduous Shrub
Crabapple*	<i>Malus sp.</i>	Deciduous Tree
Poplar (All)	<i>Populus sp.</i>	Deciduous Tree
Buckthorn (All)**	<i>Rhamnus sp.</i>	Deciduous Shrub
Rhododendrons and Azaleas	<i>Rhododendron sp.</i>	Evergreen Shrub
Dog Rose**	<i>Rosa canina</i>	Deciduous Shrub
Multiflora Rose**	<i>Rosa Multiflora</i>	Deciduous Shrub
European Mountainash	<i>Sorbus aucuparia</i>	Deciduous Tree
European Cranberry Bush**	<i>Viburnum opulus var. opulus</i>	Deciduous Shrub

*Disease Susceptible Cultivars

**Invasive Species

Disturbed lawn areas in the Brick Quarters, Fac. 10262/266, Fac. 20014/15, and other high visibility areas shall be restored with sod. Sod type shall be Kentucky Bluegrass Blend.

3.11.2 Site Elements

Consistency is the most critical factor in the selection of various site elements such as benches, trash receptacles, lighting fixtures, small shelters, and street furniture.

Designers shall pay considerable attention to maintain compatibility with similar site elements within a particular architectural district on WPAFB. When no true compatibility exists, the designer shall coordinate material selection with the ARC. When practical, a dark bronze anodized finish shall be selected for site elements on Base.

3.11.3 Fencing and Screening

Comprehensive screening considerations are a major element that could strengthen the visual image of this Base. Properly designed barriers dramatically improve the visual appearance of both facilities and the Base as a whole. Three screening types are acceptable to reduce visual clutter on this Base. Consistency and durability are critical. Well-designed screens should not draw attention to themselves and should be used at a minimum:

- Masonry
 - Selection of brick or concrete block must be compatible with the standards defined in Section 3.7 of this standard.
 - The only allowable exception to this standard is when compatibility must be maintained with an existing facility.
- Chain Link Fencing

- This type of fencing is only acceptable as a screening device when shrubbery is planted adjacent to the fencing.
- Wood Fencing
 - Wooden fences will be painted to match the approved Base paint standards illustrated in Section 3.7 of this standard.

3.11.4 Mowing Strips

In all new construction or exterior facility renovation work with an adjacent lawn, install a mowing strip along the perimeter of the facility. The strip will reduce maintenance for WPAFB grounds crews, prevent mower damage, and minimize façade repairs. The mowing strip shall be washed, rounded river rock, with 100% passing the 1.75 inch sieve and 100% retained on the 0.75 inch sieve. The material shall be placed on a minimum 8 mil thick perforated poly fabric, be of a minimum 4 inches thick, and extend to a minimum of 18 inches from the facility wall. A minimum 5 inches tall by 0.125 inch thick poly edging shall be provided at the rock to lawn interface.

3.11.5 Landscaped Beds

Per Air Force Grounds Standards, landscaped beds are authorized only at installation main entrances and installation headquarters (i.e. Wing HQ and MAJCOM HQ). Only low maintenance, indigenous flowering plants are permitted.

3.11.6 Parking Lot Islands

Parking lot islands are permitted when required for storm water control. Parking lot islands shall only be filled with stone and trees approved in 3.11.1, or concrete. Landscaped islands that include trees shall be of a sufficient size to accommodate healthy growth. No plants, flowers, or mulch are permitted.

3.11.7 Design Guide

Refer to the *Air Force Landscape Design Guide* for additional site planning and design criteria.

3.12 Interior Design Standards

In addition to the following, also reference the *WPAFB Comprehensive Interior Design (CID) Program* guidance in BFS Section 4.0.

Good design extends beyond aesthetics to provide professional durability, acoustical and energy-saving value, as well as morale enhancement for the inhabitants. The goal is to ensure the interior appearance of each facility is based on carefully established professional design standards rather than arbitrary personal preferences.

Provide a narrative description of the color design concept addressing architectural finishes and colors. Describe the materials for major items of construction and interior finishes as they fulfill the project program scope. Provide a Furniture Plan and a Furniture, Fixtures and Equipment (FF&E) List with associated cost estimates. Provide a description of furnishings and equipment not considered to be part of the structure with an estimated cost. This will be used to refine funding needs for the FF&E in the event that the Comprehensive Interior Design (CID) Option is exercised.

3.12.1 Furniture Plans

Furniture Plans are considered part of the project scope of work. The A/E must work directly with the Activity to assess their needs and develop a written program of equipment and furnishings required for each space within the facility. The furniture plans are developed to show that the furnishings necessary for the user's functional requirements can be accommodated within the spaces, comply with ABA standards, and satisfy applicable NFPA 101 Life Safety requirements. Selection of systems and modular furniture for basis of design will be in accordance with the Mandatory Use Policy for Air Force (AF) Systems and Modular Furniture Acquisitions. The furniture plans and documented user requirements serve as the basis for a fully integrated architectural and interior design; and serves as the basis for the Furniture, Fixtures & Equipment (FF&E) package. They are also utilized for coordination of other architectural elements and engineering disciplines (lighting, power, mechanical, window placement, etc.) with respect to furniture placement.

If furnishings are not included as part of the construction contract, ensure that the furniture plans are clearly noted "For Reference Only." Design Development, 100% and Final Submittals must include Furniture Plans as part of the drawing set.

3.12.2 Interior Finishes

Permanent finishes (ceramic tile, counter tops, vinyl tile, etc.) shall be neutral tones. Richer accent colors may be used only in small areas. Classic timeless textures and colors are desired and trendy patterns and colors shall be avoided.

Ease of maintenance and a professional appearance should be the foremost criteria in selection of interior finishes. Dark patterned carpet hides soil and traffic paths; semi-gloss or eggshell finish paints are washable; light tones are to be used on walls and ceilings, etc. Corner guards and chair rails should be used to protect wall coverings.

Type II commercial vinyl wall coverings are recommended. Muted neutral colors and subtle textures are preferred to strong patterns. When using chair rails, wall coverings shall be used below with paint above.

Ceilings shall be suspended acoustical systems with 610mm x 610mm or 610mm x 1220mm (2' x 2' or 2' x 4') tile to provide for ease of maintenance. A recessed grid with drop edge tile is preferred.

3.12.3 Carpet

Refer to Air Force Carpet Standard ETL 07-4

3.12.4 Prewired Workstations (PWWS)

To provide the most flexible facility possible, prewired workstations are the standard for furnishing open office areas, where panel-based systems are required. Desking systems (non-wired) provide greater flexibility where wall COMM, data & power outlets are available. Selection of the PWWS manufacturer should be based on the system that provides the most durable components, such as factory painted metal storage units and trim.

3.13 Energy Conservation

Energy costs account for a significant portion of the Defense budget. In light of this, the Department of Defense (DOD) has established rigorous energy cost reduction objectives for subordinate agencies. Meeting these objectives requires the scrutiny of elements of our operations to determine areas of potential improvement. Architectural design of energy-efficient facilities is one such area. Additional Energy Conservation issues are addressed in Sections 5 and 7 of this Standard

3.13.1 Base Energy Manager

In accordance with DOD objectives to reduce energy consumption, WPAFB has assigned a Base Energy Management Team to focus energy conservation efforts. The Base Energy Management Team is responsible for creating and implementing various energy plans. The Point of Contact is:

88 CEG/CENPE
Mr. Michael Tibbs
5151 Wright Avenue
Wright-Patterson AFB OH 45433-5332
656-3394

3.13.2 Energy Annex to the AFMC Energy Plan

This annex outlines the WPAFB Energy Program, defines its objectives, and describes future alternatives. The energy program addresses goals and initiatives taken and proposed to reduce energy consumption and costs and to improve energy efficiency.

3.14 Overhead Doors

Install sectional overhead doors to the fullest extent. Coordinate with CE Project Manager where roll-up overhead doors may instead be required due to mission impact or limited overhead storage space.

3.15 Door Hardware

Provide cylinders for new locks, including locks provided under other sections of this specification. Provide small-format interchangeable-core cylinders with seven-pin tumblers fully compatible with the Stanley Best Access Systems 1E series. Cores shall be of solid brass construction with individually capped barrels, in the Stanley Best Access Systems “TE” keyway, as manufactured by either Oak Security Group or Stanley Best Access Systems, and shipped uncombined directly from the supplier to the Base Lock Shop (88 CES/CEOHS, 1450 Litrell Road, Bldg 30027 Door #4, Wright-Patterson AFB OH 45433). Furnish two blank keys for each core. Provide temporary cores as required for the protection of materials, equipment, and work area. The Government shall combine and install the permanent cores.

3.15.1 All mechanical, electrical, and Comm equipment rooms shall be securable.

3.15.2 Access Panels

Where it is deemed necessary to provide lockable hardware on access panels, follow the above door hardware guidelines regarding locks, cylinders and blank keys.

3.15.3 All open office, private office, and conference room doors shall be securable and equipped with a secure side thumb turn or push button for quick activation of key lock mechanism.

3.16 Secure Working Areas and Open Storage Areas

Collateral secure facilities shall be in compliance with the 88 ABW/IPI WPAFB Facility Construction Standards Memo (<https://cs.eis.afmc.af.mil/sites/SF-IP/88ABW/InformationSecurity/Physical%20Security/Forms/AllItems.aspx?RootFolder=%2fsites%2fSF%2dIP%2f88ABW%2fInformationSecurity%2fPhysical%20Security%2fPolicy%2fConstruction%20Standards&FolderCTID=&View=%7b2D80F0F3%2d2EF5%2d4FA1%2dA059%2d80C6153FF2A9%7d>).

3.16.1 Secure Working Areas, SIPRNET rooms, and other spaces intended for communication or analysis (but not open storage) of classified materials or information shall at minimum be designed to meet the physical construction and acoustic protection (for Sound Group 3 or Sound Group 4, as applicable) standards for Secure Working Areas as defined in the IC Tech Spec for ICD/ICS 705. More stringent requirements may also apply. Coordinate

project-specific requirements with Information Protection – Physical Security and end user’s security manager through the CE Design Manager.

3.16.2 Open Storage Areas and other spaces intended for storage of classified materials or information shall at minimum be designed to meet the physical security standards of DOD Manual 5200.01, Volume 3, and the acoustic protection standards (for Sound Group 3 or Sound Group 4, as applicable) of the IC Tech Spec for ICD/ICS 705. More stringent requirements may also apply. Coordinate project-specific requirements with Information Protection – Physical Security and end user’s security manager through the CE Design Manager.

3.17 Removal of “Fiberboard”

The A/E shall be responsible to identify combustible material within the project area described as "fiberboard" or "fuzzboard" and indicate its removal and replacement on the final drawings and specifications. In some instances this includes plywood-backing board.

3.18 Exterior Finish and Color Schedule

The A/E is responsible for selection and coordination of final exterior finish and color selections using this document, after obtaining input from the using activity and the DM (reference Section 3.7). Indicate these selections on a comprehensive schedule located on the contract drawings, indicating selections for exterior materials. Locate this schedule either on the finish schedule sheet or on the sheet with the exterior building elevations. When matching existing materials and colors, it is not sufficient to state, “Match Existing.” Identify specific existing materials and colors. In no case shall the selection of colors or finishes be left up to the DM, the Contracting Officer or his representative.

3.18.1 Architectural Compatibility Submittal

The Architectural Compatibility Submittal documents the exterior architectural design of a new facility or major renovation. Determine architectural compatibility at the concept stage of the project. This submittal must provide adequate documentation that indicates the materials, colors, and design elements used on the exterior for the building are compatible with other structures nearby, and with other design guidance required by the ARC

This is a separate submittal that must be submitted early in the design process; normally at the 35% design level. It will be used by the DM to present to the ARC and therefore must be in a format that the A/E would feel comfortable presenting.

3.18.2 Architectural Compatibility Submittal Format

The Architectural Compatibility Submittal consists of four elements:

- **Statement of Compatibility:** Provide a brief description of the design, stating concisely the architectural compatibility of the project with respect to the existing nearby permanent facilities and the BFS. Include not only building characteristics, but also a site analysis, visual environment concept, and appropriateness of construction materials and colors.
- **Drawings:**
 - **Site Plan** – Indicate site boundaries, building locations (existing, proposed and future) drives and roads, parking, pedestrian circulation, pedestrian and service entrances, landscaping and antiterrorism boundaries.
 - **Floor Plan** – Indicate main entrances, service areas, room designations and exterior stairs and ramps.
 - **Elevations** – Provide building elevations, and indicate exterior materials, architectural characteristics and design elements.
- **Exterior Color Board:** Provide actual samples of exterior materials and colors. When matching existing materials and colors, it is not sufficient to state, “match existing”.
- **Photographs:** Provide sufficient digital photographs to indicate the character of the existing nearby facilities, which have influence on the architectural design of the project. Reference photograph locations on the Site Plan or with a key plan.

3.19 Design Document Standards

Refer to Appendix A, WPAFB CADD Standards, for specific requirements concerning design documents in addition to the following.

3.19.1 Dimensioning

Provide adequate dimensions on each floor plan so that it is not necessary to refer to other drawings in order to determine dimensions. Provide vertical dimensions on elevations and sections.

3.19.2 Referencing

Reference symbols (section and detail cuts) shall be used liberally on the drawings to eliminate having to guess which section or detail applies.

3.19.3 Proper Use of Notes on Drawings

Be consistent with grammar used in notes on drawings. Wherever possible use declarative statements to describe work to be accomplished by Contractor. For example, instead of using “Contractor shall provide,” use “provide.” It is understood that the notes are written for the Contractor’s action. The Contractor is responsible for performing the work as shown and specified; therefore, there is no reason to use the phrase, “the Contractor shall.”

Speak only to the Contractor, not the supplier or manufacturer. The Contractor cannot be directed through the manufacturer or supplier or vice versa. Stating “the manufacturer shall provide []” could be interpreted as simply informing the Contractor that a party other than the Contractor is responsible, comparable to “the Government shall provide []”. Likewise, there is usually no reason to differentiate between actions expected of the “Contractor” and the Contractor’s various suppliers, to attempt to do so borders closely on an assignment of work.

Do not use “to be” for describing work that will be accomplished by the Contractor. “To be” implies that someone will accomplish the work other than the Contractor, such as the government or another Contractor. If work is to be accomplished by Government, for example, say “Government will remove storage building prior to start of construction.”

Do not use “install” for work that is to be accomplished by the Contractor. “Install” means Government or others will furnish equipment or materials and Contractor will install. “Furnish” means Contractor shall only furnish; Government or others will install. Use “provide” when the Contractor is to furnish and install equipment and materials.

Do not use “proposed” for new construction. “Proposed” means future work by others or work not in this contract.

Do not use “new” for work in the contract. Work shown on the drawings is considered new, unless indicated otherwise. Inconsistent use of “new” throughout the drawings could mean that only some of the work is required.

Do not use ambiguous statements that cannot be enforced by the inspector during construction. For example: “grade to drain;” “hand excavate carefully;” “provide materials in good condition.”

Be careful with statements like “remove and replace,” which means to remove old item or material and replace that item or material when work is completed. This statement would be appropriate for work in a pump station where pumps were removed prior to the work and those same pumps replaced after the work is completed. On the contrary, if a portion of a concrete walk is cracked and requires replacement, say “remove and provide concrete walk.”

When referring to requirement for coordination between Contractor and Government agency, for example use “coordinate utility connection with Contracting Officer.”

Do not indicate, “see specifications” on the drawings. The drawings and the specifications form a complete construction package.

Do not use all or any.

Do not use words that have multiple meanings, requiring opinions, or judgmental decisions, such as “timely,” “nearly,” “good-condition,” “suitable,” “well-balanced,” “suitable for

intended use,” “reasonable,” “approximately,” “reliable,” “proper,” “usable,” “appropriate,” “adequate,” or “qualified.”

Do not use terms that are not biddable by the Contractor nor enforceable by the Government, such as “recondition,” “as directed,” “equal to,” “as required,” “similar to,” “as necessary,” “as close as possible,” “repair,” “match existing,” or “refurbish.”

Some terms are only enforceable if quantities are shown on the drawings or included in the specifications, such as “as indicated,” “as shown,” “specified herein,” and “as noted.”

Be careful when using the word, “typical,” especially if there are exceptions to the detail.

4.0 **COMPREHENSIVE INTERIOR DESIGN**

4.1 **General**

4.1.1 Purpose

4.1.1.1 Provide guidance in initiating and executing Comprehensive Interior Design (CID) projects, whether by in-house or contracted out sources.

4.1.1.2 Support the Air Force Civil Engineer Strategic Plan. This program is an essential element for wise facility investment strategies. Well-designed interiors are a business issue, not only a facilities issue.

4.1.1.3 Designs shall be in conformance with the latest editions of UFC's, ETL's, AFI's, Air Force Criteria, and also in conjunction with the Air Force Corporate Facility Standards (AFCFS, <http://afcfs.com>).

4.1.1.4 Provide facilities that support the Air Force's varied missions and contributes to attracting and retaining a quality workforce. Success of the ID program relies on the 88 CEG, using agencies, and Contracting, vigorously working together.

4.1.2 Goal

4.1.2.1 To ensure the interiors of WPAFB facilities satisfy user mission requirements, expectations, and include function, anthropometric and ergonomic considerations, maintenance, durability, sustainability, comfort and life cycle costs.

4.1.2.2 To have an appropriate corporate image. This includes compatible, professionally designed, and code compliant environments.

4.1.2.3 To ensure military interiors are equally respectful of image, function, environment, and economy. Must be timeless, not stylistic, dignified, serious, and rational, reflect function, respectful and subservient to the whole, and cost effective.

4.1.2.4 To ensure the facility interiors are flexible as possible to meet the dynamic requirements of our mission. While the primary function of the facility must be the priority, functions evolve, and the facility's configuration and infrastructure must support evolving technologies, work processes, and organizational structure. Flexibility is a significant design requirement, except for buildings with highly specialized functions where adaptive reuse would be cost prohibitive.

4.1.2.5 To respect WPAFB's regional architectural influences and historical factors including existing built environments.

4.1.3 Scope

4.1.3.1 This guidance encompasses all facilities in the MILCON, O&M (including in-house, SABER and self-help), NAF, MFH programs, Base-wide Furniture Maintenance IDIQ Contract, and Base-wide Flooring IDIQ Contract.

4.1.3.2 All interior design projects are to be reviewed by 88 CEG/CEN.

4.1.4 Codes and Publications

Designs shall be in conformance with the applicable portions of the latest editions of the following codes and publications:

- UFC 3-120-01; Air Force Sign Standard
- UFC 3-120-10; Interior Design
- UFC 4-610-01N; Administrative Facilities
- AFMAN 32-1084; Civil Engineering Facility Requirements
- ETL 07-4; AF Carpet Standards
- ETL 04-3; Design Criteria for the Prevention of Mold in Air Force Facilities,
- US Air Force Interior Design Standards
(<http://www.wbdg.org/ccb/AF/AFDG/interiordesign.pdf>)

4.1.5 Air Force Installation Contracting Agency (AFICA) Mandatory Blanket Purchase Agreements (BPA's) and Furnishing Contracts

Comply with all Mandatory BPA's and Contracts regarding selection of product, furniture, and finishes

(<https://ce.eis.af.mil/airforcecontracting/AFICA/AFFCC/default.aspx>). Contact 88 CEG/CEN Project Manager for applicable documents and reference links.

4.2 Overview of Military Interior Design

4.2.1 CID Categories

4.2.1.1 Structural Interior Design (SID) is the design of building related interior finishes such as walls, ceilings, floor coverings, built-in casework, etc., and includes the design of the furniture footprint. Structural Interior Design is funded with military construction funds appropriated by Congress or with Non-Appropriated Funds (NAF).

4.2.1.2 Furnishings, Fixtures & Equipment (FF&E) Interior Design is the design of interior furnishings and their finishes. The FF&E package is developed during the facility and SID design phase of a project and implemented during the construction phase of a project. FF&E is the selection and illustration of all furnishings (interior and in some cases exterior furnishings) required to meet the functional and operational needs of the facility. Selection of systems and modular furniture will be in accordance with the Mandatory Use Policy for Air Force (AF) Systems and Modular Furniture Acquisitions and procured through the Air Force Enterprise process. Selection of filing and storage will be in accordance with the Mandatory Use Policy for Filing and Storage Furniture, procured through Air Force Advantage website (<https://www.afadvantage.gov>). The FF&E includes market research narratives and "best value" determination statements, samples of furniture finishes, furniture placement plans, illustrated order forms and a comprehensive cost estimate. The FF&E is to be fully coordinated with the SID, architectural layout, and building engineered system designs to ensure a fully integrated SID/FF&E project is developed to meet User/project requirements. The FF&E design, like the SID design, is funded with Military Construction Funds

when the FF&E is documented as part of the project requirements described in the DD 1391. However, procurement and installation of the FF&E package is funded with operations and maintenance (O&M) funding requested by the User Group and funded by their command. SID and FF&E are two separate and distinct projects at execution phase.

4.2.2 Development Meeting

As early as possible and before initiating an interior design project, a FF&E procurement strategy discussion, with Contracting, is to be held in conjunction with the facility design criteria review meeting.

4.2.3 Project Delivery Process

100% of the SID/FF&E will be developed by a single interior design source in Design-Build or Design-Bid-Build format. Reference UFC 3-120-10 for full explanation of the delivery process.

4.3 SID/FF&E Requirements and Information

4.3.1 Specification Forms

Illustrated Order Forms (IFO) are used to specify freestanding furniture and equipment.

4.3.2 Computer Software Requirements

Digital deliverables are to be developed using the software programs listed below. All digital data files shall be delivered in a format that is directly readable and compatible with the CADD, MS Excel, Adobe Acrobat software and platforms without conversion.

Delivered Item	Software
Drawings	Refer to BFS Appendix A for guidance
Specifications	UFGS edited with SpecsIntact software
Ordering Data	Latest version of MS Excel (.xls)
SID/FF&E Record Copy	Latest version of Adobe Acrobat Read/Write portable doc format (.pdf)

4.3.3 Reviews and Revisions

- | 4.3.3.1 Reviews of SID/FF&E projects are to be performed by 88 CEG/CEN regardless of the project delivery process. Revisions and updates will require hard copy and digital copies of the SID/FF&E to be refreshed and resubmitted at the next formal submission unless otherwise required by the reviewer.

4.3.4 SID – Interior Finishes

| 4.3.4.1 Codes and Publications

Designs shall be in conformance with the applicable portions of the latest editions of the following codes and publications:

- NFPA 101; Chapter 10, Interior Finish, Contents, and Furnishings

- Air Force Interior Design Standards
(<http://www.wbdg.org/ccb/AF/AFDG/interiordesign.pdf>)

4.3.4.2 Color Schemes

Color is an important part of the first impression of any facility. A well-planned color scheme, followed throughout a building, portrays it as organized and stable. The late 20th century has brought a lightening of the corporate office palette and a greater emphasis on muted neutrals. Neutral colors provide flexibility, but when used in abundance can detract from a productive atmosphere. Accent colors on carpets, upholstery, focus walls, and artwork, provides visual stimulation. Colors must have lasting appeal and ultimately blend well with other recent palettes. Color Schemes are to be appropriate to WPAFB's predominant regional characteristics.

4.3.4.3 Finishes are to be selected in keeping with the ultimate goal of timeless maintainable interiors.

4.3.4.4 Ceiling and wall finishes are to be the lightest color possible, while maintaining the integrity of the design and function of the space, and not interfering with concentration and creating visual fatigue. Ceilings are to have 80-90% and walls 40-60% light reflectance values.

4.3.4.5 Ceiling Finishes

4.3.4.5.1 Choose the ceiling finish based on the space's function, paying attention to environmental conditions created by the organization's equipment.

4.3.4.5.2 Install ceilings in administrative spaces comprised of 2'x2' or 2'x4' suspended acoustical ceiling systems to the fullest extent. For an upgraded appearance, tiles can be scored to appear 2'x2' or 1'x1'. Perimeter framed gypsum board soffits/headers are to be designed in when necessary for design integrity or utility encasement.

4.3.4.5.3 To enable the facility maintenance staff to respond as quick as possible to repair or replace suspended ceiling tiles, it is preferred that new specified ceiling tiles match the stocked 88 CEG tiles Armstrong's 755B.

4.3.4.6 Wall Finishes

4.3.4.6.1 Staff level and mid-level management spaces are to have egg-shell finish painted gypsum board walls.

4.3.4.6.2 Polyolefin woven wall coverings can be used in senior management office suites. To minimize or eliminate paneling, patterns are to be non-directional or vertically oriented, no horizontals.

4.3.4.6.3 Multi-colored paint systems can be used in corridor spaces of highly visible administrative facilities. Less visible or very high cart traffic corridor spaces are to have solid painted gypsum board walls or other prior approved high impact resistant wall panels.

4.3.4.6.4 Acoustical wall covering is to be used in spaces where sound transmission is an issue, and in conjunction with acoustical sound batt insulation

installed inside the walls. To minimize or eliminate paneling, patterns are to be non-directional or vertically oriented, no horizontals.

- 4.3.4.6.5 Install bumper guards in high cart traffic areas. Chair railing may be installed in areas other than conference rooms with 88 CEG/CEN approval.

4.3.4.7 Floor Finishes

- 4.3.4.7.1 Refer to ETL 07-4 Air Force Carpet Standards for further guidance (http://wbdg.org/ccb/AF/AFETL/etl_07_4.pdf).

- 4.3.4.7.2 To disguise soiling and traffic patterns, carpeted surfaces are to have a patterned variation of medium and medium/dark shades, with minimum use of solid colors.

- 4.3.4.7.3 To minimize the appearance of salt and hard water deposits, resilient and hard flooring surfaces are to be in medium tones, with minimum use of light and dark tones.

- 4.3.4.7.4 Administrative environments are to use modular carpet tiles. Senior Management and General Officer private offices can use broadloom carpeting. In-laid carpet borders can be used in high visibility conference rooms, entries into significant facilities, and primary circulation spaces, no private offices.

- 4.3.4.7.5 Multi-level or level loop carpet is to be used in open office and high traffic administrative spaces. Dense cut pile carpet can be used in low traffic senior management office suites.

- 4.3.4.7.6 Carpets with overprinted graphics are to have at least an 85% penetration rate on the exposed yarn fiber.

- 4.3.4.7.7 Only type 6 Nylon or 6,6 Nylon carpet fiber is to be used in carpeting. Solution dyed yarn is required.

- 4.3.4.7.8 Ceramic tile flooring - use textured unglazed tile flooring products in high traffic areas (i.e., entries, kitchens, restrooms, corridors, and copy rooms).

- 4.3.4.7.9 All areas that are to have ceramic tile floors, including high use public restrooms, are to have epoxy grout.

- 4.3.4.7.10 All building entry points are to have large areas of in-laid walk-off matting, to the fullest extent possible, to extend the life of the adjacent flooring.

- 4.3.4.7.11 Where budget is a controlling issue, vinyl composition or solid vinyl tile can be used in high traffic and high abuse areas.

4.3.4.8 Built-Ins

- 4.3.4.8.1 The use of built-in cabinetry is to be explored only when freestanding furniture won't fulfill the user's requirements or is less expensive option.

4.3.4.8.2 If built-in cabinetry is utilized, only timeless detailing, finishes, colors, and durable finishes are to be used. Incorporate wire management features into built-ins.

4.3.4.8.3 Provide adequate and aesthetic staff and guest coat storage in all administrative spaces.

4.3.4.9 Extra Stock

Specifications for all interiors finishes and signage are to include statements to provide the using agency with extra stock materials for future repair or replacement. The extra stock supplied can be requested in the form of number of units or a percentage of the total installed.

4.3.5 Restroom Accessories

4.3.5.1 Paper Towel Dispensers (PTD)

PTD shall be of high-impact white plastic or prefinished white metal construction, and shall automatically advance and cut an approximate 12" length of paper towel when exposed portion of towel is pulled. PTD shall be listed by the manufacturer to accept Skilcraft #8540-01-592-3324 Continuous Roll Paper Towels in 8" x 800' rolls with 1.5" diameter cores. Basis of design is Kimberly Clark #09991 Windows Sanitouch Roll Towel Dispenser.

4.3.5.2 Soap Dispensers (SD)

SD shall be of high-impact white plastic or prefinished white metal construction, manually operated via press plate or pushbutton, and shall be listed by the manufacturer to accept GOJO #8520-00-NIB-0151 1250ml soap cassettes. Basis of design is GOJO Skilcraft #4510-01-521-9869 Wall Dispenser.

4.3.5.3 Toilet Tissue Dispensers (TTD)

TTD shall be of high-impact white plastic or prefinished white metal construction, designed to minimize tissue runout and with lockable hinged cover. TTD shall be listed by the manufacturer to accept Skilcraft #8540-01-590-9068 Jumbo Roll Tissue in 3.55" x 2000' rolls with 3.25" diameter cores. Basis of design is Kimberly Clark #09551 Cored JRT Jumbo Combo Tissue Dispenser.

4.3.5.4 Architectural Barriers Act Accessibility Standards (ABA) must be followed for mounting locations, along with the following placement information. Toilet tissue dispensers in standard stalls are to be installed with center line of unit to be 12" from front edge of water closet. Toilet tissue dispensers of handicap stalls are to be installed with center line of unit even with front edge of water closet.

4.3.5.5 No feminine product dispensers are to be installed in women's restrooms. Feminine product waste receptacles can be placed in the water closet stalls, provided the facility user provides trash bags for the waste receptacles. The

Cleaning Contract Service will only be responsible for emptying the individual trash receptacles which utilize a trash bag liner.

4.3.5.6 Provide 8" D stainless steel shelves over all wall hung lavatories, full-length mirror, and a multi-hook coat bar, in all public restrooms. A full-length mirror to also be installed in private executive restrooms.

4.3.5.7 Public restrooms shall have wall hung lavatories. Countertops with recessed sinks may be utilized in HQ type facilities or private and low traffic restrooms where approved by the ARC. Due to the Base's high mineral content water, vanity colors are to be light to medium tones.

4.3.6 Furnishings, Fixtures, & Equipment (FF&E) Projects

4.3.6.1 All proposed furniture layouts for procurement are to be dimensioned to scale and approved by a designated Designer of Record for Life Safety in accordance with NFPA 101, (whether for GPC Purchase, through Air Force Buying Purchase Agreements (BPA's) or through Contracting (PZ)). Prior to all furniture purchases this letter of Life Safety compliance must be provided to 88 CEG/CEN for review.

4.3.6.2 Resources

The FF&E package is a consolidated procurement package of commercial items. To simplify and streamline the procurement process and obtain the items specified in the FF&E, the designer is to use the resources and follow the FAR 8, Subpart 8.4 Federal Supply Schedules (FSS). When a FF&E package is ready to implement, ordering offices issue delivery orders directly to the schedule contractors for the required furniture and service. All GSA FSS contractors have been evaluated and their products tested to ensure all Federal agencies are provided with the same service and pricing. GSA FSS provide a variety of contractors supplying comparable items and services at varying prices to provide the designer and User with the flexibility to select the "best value" items that meets the requirements of the User and FF&E project.

4.3.6.3 Documenting "Best Value" Requirements

4.3.6.3.1 The FAR mandates that all commercial items (furniture and related services) acquisitions use and document two separate and distinct criteria to reach a "best value" determination before commercial items can be purchased. The two criteria are: (1) market research and (2) price reasonableness. Though these two determinations may both consider the same information obtained during market research, they are separate and distinct from each other. The documentation of price reasonableness is required for all contract awards. The "Best Value Statement" for all FF&E packages will document both criteria. In addition, the FF&E "Best Value Statement" will also document the market research and price reasonableness of UNICOR's products as well. Although the DOD is not mandated to obtain a UNICOR waiver or required to buy from UNICOR, it is a requirement that UNICOR products be considered when developing a FF&E package.

4.3.6.4 Furniture Systems

4.3.6.4.1 Furniture system workstations, either desk-based, panel-based or a frame and tile system, are to be fully coordinated with the building's finishes, architectural layout, structural, electrical, and mechanical systems.

4.3.6.4.2 Furniture system workstations are intended to function as hard walled offices providing some degree of acoustical and visual privacy in addition to having power, voice and data (PVD) network distribution outlets like one would find in a hard walled office. Workstation designs and layouts are required to fully coordinate with the life safety plan, audio and visual alarms and the fire suppression system to ensure the "building within the building" supports life safety.

4.3.6.4.3 Power, communications, and data feeds to furniture systems are to come from column enclosures or full-height interior architectural elements.

4.3.6.4.4 Workstation solutions for projects are not only to be designed for project specific requirements but are required to facilitate future office reconfiguration. Workstations are to be selected for their best value features, durability, flexibility, and ease of reconfiguration. Workstations are to offer limited interruption of the PVD when reconfiguration occurs and are to be easily adaptable to incorporate new technology.

4.3.6.4.5 Workstations are to provide ergonomic features such as adjustable height work surfaces, fully articulating keyboards with parallel and changeable mouse pads, and paper management and storage tools to support tasking. A suitable, ergonomically designed task chair, with width and height adjustable arms, is to be specified for each workstation. To the fullest extent possible, avoid placing an occupied workstation next to common use areas such as semi-private conference spaces, copy areas or "food prep" areas.

4.3.6.4.6 All modular wall and furniture panels are to have the same fabric and color throughout a facility, no accent panels, for ease of future reconfigurations and flexibility, unless otherwise by 88 CEG/CEN.

4.3.6.4.7 All furniture componentry is to be mid-range neutrals and as homogeneous as possible, with stronger colors introduced with the seating.

4.3.6.5 Freestanding Furniture

4.3.6.5.1 Refer to AFCEE Interior Design Presentation Format for definitions.

4.3.6.5.2 FF&E is also to include appliances for kitchenettes and break areas.

4.3.6.5.3 Tables

Conference/training room tables are to have power and communication ports to support electronic-based meetings. Use modular, gangable, folding tables where practical. All table tops except for the highest ranking upper management offices are to be finished with plastic laminate

tops. Wood edging may be introduced if wood is a strong common design element.

4.3.6.5.4

Seating

4.3.6.5.4.1

In accordance with the Mandatory Use Policy for Air Force (AF) Office Seating Acquisitions, all seating purchases must be sourced through the Seating Buying Purchase Agreement (BPA) located on the Air Force Advantage website (<http://www.afadvantage.gov/>).

4.3.6.5.4.2

Upholstery. Use fabric that tests out with at least 35,000 double rubs in the Wyzenbeck Test. Utilize patterned fabrics on lounge, guest, and conferencing chairs, use solid or patterned fabrics at the task chairs. Leather to be used only in the highest of upper management's offices.

4.3.6.5.4.3

Task seating. Use a 5 prong base for stability. Casters should be a dual hard wheel for carpet or single soft wheel for hard floor surfaces. Do not use fabric covered arm rests on high use chairs, use durable urethane, or other solid finish. Backs must have lumbar support and tilt independently of the seat pan. Must have a minimum of 5" height adjustability and swivel capability. The seat is to have a "waterfall" front edge. Arms are to be height and width adjustable T-arms.

4.3.6.5.4.4

Conference chairs. Must have casters and swivel capability. Gallery chairs can have stacking capability or not, depending on the user's requirement.

4.3.6.5.5

Storage

4.3.6.5.5.1

Centralized common file banks is preferred over storage cabinets in individual workstations.

4.3.6.5.5.2

Utilize freestanding filing, as opposed to stacked storage bins on modular walls, as much as possible.

4.3.6.5.6

Conference/Training Rooms

Conference rooms range from formal to casual, large to small, and simple meeting to video presentation capable, depending on the functions that will take place in these rooms. The Designer of Record (DoR) needs to ensure all infrastructure requirements are fully coordinated with appropriate disciplines and incorporated into the design.

4.3.6.6

Artwork

4.3.6.6.1

The term artwork here refers to all wall hung photographic, text images, banners, and plaques.

4.3.6.6.2

All artwork must be framed and under clear acrylic or glass. Images painted directly on wall surfaces are highly discouraged and must have prior approval by an 88 CEG/CEN Architect or Interior Designer.

- 4.3.6.6.3 Artwork should be selected in appropriate proportions to the space it is in.
- 4.3.6.6.4 Halls and corridors are appropriate locations for abstract art, traditional landscapes, or organizational art quality photos. Traditional landscapes work well in private offices.
- 4.3.6.7 Bulletin Boards
- Bulletin boards are to be located in less public areas, away from main guest entry points and lobbies, and in areas such as break rooms, coffee areas, and coat storage areas. In consideration of the requirement to display information, it is the RPB's responsibility to control what is displayed to prevent the display of parties and personal ads.
- 4.3.6.8 Waste Receptacles and Recycle Bins shall be a medium tone neutral color which coordinates with surrounding interior finishes. Waste receptacles and recycle bins shall be clearly discernible from one another. Recycle bins/containers shall be clearly labeled as to what type of recyclable materials can be placed within the bin/container. Waste receptacles and recycle bins/container shall be made of a homogenous material that is easily maintained.
- 4.3.6.9 Interior Signage
- 4.3.6.9.1 Refer to the Unified Facilities Criteria UFC 3-120-01 Air Force Sign Standard (<http://www.wbdg.org/ccb/DOD/UFC/ufc 3 120 01.pdf>), for full Interior Signage guidance, with the following WPAFB exceptions or supplemental information.
- 4.3.6.9.2 Color
- All interior signage is to have a light warm gray or cool gray field with black text. The same selection is to be utilized throughout an entire building, regardless of the number of tenant organizations.
- 4.3.6.9.3 Components of Type AA1 (11.9.2)
- The directory section is a changeable strip board with die-cut vinyl letters. It lists tenant organization names and not individual personnel names.
- 4.3.6.9.4 Office Identification Sign Types (11.13)
- Sign types BB1 to identify a major office area in a building (such as a wing or annex) and sign type BB2 for all other designated offices, are the preferred office sign types for WPAFB.
- 4.3.6.9.5 Office Identification Sign Type BB7 (11.14)
- Sign type BB7 is to be used for all static building service areas, such as electrical, mechanical, and communication closets.
- 4.3.6.9.6 Funding

As part of a facility rehab project, interior signage is an SID item and is designed and funded with construction funds. If there is no facility rehab project, interior signage is a FF&E item and User funded.

4.3.6.9.7

Mounting

Flush wall mounted or furniture panel mounted signs are preferred over ceiling or wall projecting signs.

4.3.6.9.8

Room Numbering

4.3.6.9.8.1

To provide continuity throughout the Base, it is highly recommended that all facilities comply with the following standard room numbering system. The easiest time to implement the new numbering for an existing facility is at building renovation or procurement of new interior signage.

4.3.6.9.8.2

All interior spaces is to be based on three digit numerals, the first digit representing the floor of the building (i.e. 0 for basement, 1 for first floor, etc.), the second and third digits being the room number.

4.3.6.9.8.3

The numbering of the spaces are to proceed through the building counterclockwise, keeping odd and even numbers on opposite sides of corridors. All rooms, regardless of their function, are to receive a room number. Only rooms directly off of corridors are to receive their own room number. All rooms within rooms are to receive the same room number with a letter suffix (i.e. 205A, 205B, etc.). All open office workstations are to be numbered, with the same room number they are contained in, and a decimal point and numerical suffix (108.9, 108.10, etc.).

4.3.6.9.8.4

All similar spaces on successive floors are to have the same second and third digit room numbers as the other floors (031, 131, 231).

4.3.6.9.8.5

Stairs are to be numbered for the building (i.e. Stair 1, Stair 2, etc.).

4.3.6.10

Window Treatment

4.3.6.10.1

Windows under 42" wide, in general administrative areas, are to have 1" wide horizontal metal blinds. Windows over 42" wide, in general administrative areas, are to have a translucent mesh roller system to reduce solar glare and heat gain, without prohibiting outdoor views. A denser mesh is to be installed on the west and south elevations, than on the north and east elevations.

4.3.6.10.2

Upper level management administrative areas can utilize vertical vinyl blinds with woven fabric or wall covering inserts. Woven fabric inserts must pass NFPA 701 large and small flame resistance test.

4.3.6.10.3 General Officer or Senior Management spaces

Due to high maintenance, the use of drapes is to be minimized and only used in senior management or hospitality spaces. Window treatment to consist of full length two-way draw pinch pleated drapes with tailored fabric covered cornice boards.

Drapery Specification:

100% Fullness

Pinch Pleated

3 Pass Blackout Lining

Fabric passes NFPA 701 large and small flame resistance test

Side hems to be 1-1/2" double turned and blind stitched

Blackout lining 3" turned hem, not surged bottom hem

Base cloth shall be a minimum of 7oz

Pattern match on fabrics

Seams hidden in pleats

Full length to floor

Outside mount on wall face and extend 6" beyond each side of window

Hardware Specification:

Commercial weight center-meet traverse rod with cord

Projecting end brackets, minimum profile, to pass over architectural trim and molding.

4.3.7 FF&E Installed by the User Group

If the client/User Group is installing the FF&E package, including furniture systems (pre-wired) workstations, all furniture system related drawings should be indicated in the SID contract drawings with the note "FOR INFORMATION ONLY". See section on furniture system drawings and specification requirements.

4.3.8 FF&E Installed by the Construction Contractor

The Designer of Record (DoR) for Design-Build or Design-Bid-Build contracts shall ensure that all Contractor and Government obligations regarding FF&E are clearly defined and stated in the contract documents (100% Design Drawings/Specifications, RFP, and Bidding Documents (Base Bid/Options)).

4.4 Federal Prison Industries (UNICOR)

4.4.1 Refer to UFC 3-120-10 Appendix D for guidance on Federal Prison Industries.

4.4.2 UNICOR Schedule of Products is provided at www.unicor.gov.

4.5 Interior Workspace Usage/Criteria

4.5.1 The standardizing of personal work space is to proactively manage facility space. As much as practical, space allotment is based on function, not status. All standards listed are WPAFB objective goals. ALL deviations must be approved by 88 CEG/CEN, at the earliest possible design stage.

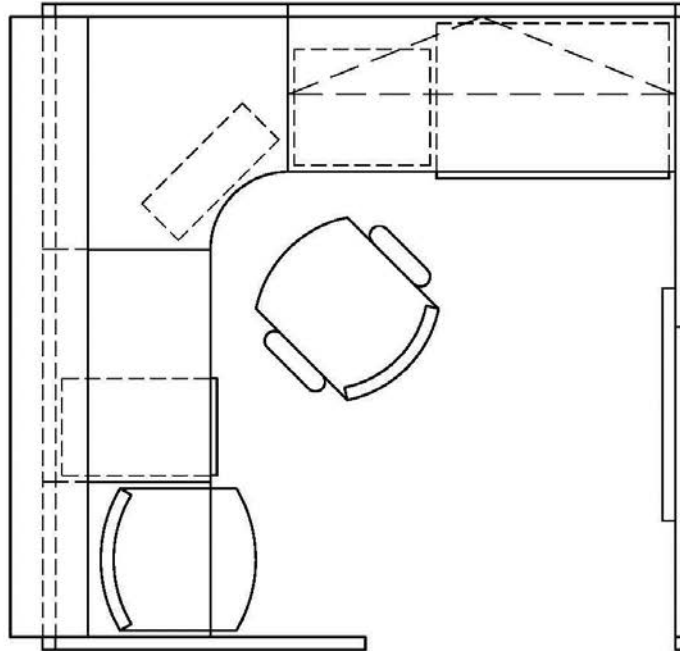
- 4.5.2 Interiors shall provide balance of private personal space with acoustic separation for concentration and quiet work; common team space for informal interaction and impromptu meetings; and public space.
- 4.5.3 Interior spaces shall consist of flexible administrative and specialty space with minimum use of floor-to-ceiling walls. The flexibility will be accomplished through the use of furniture systems as much as possible. Floor-to-ceiling spaces will be approved on a case-by-case basis.
- 4.5.4 Reference Air Force Manual 32-1084 Section 6.1 "Administrative and Administrative Support Spaces" for explanation of area and space terms. Reference Tables 6.2 "Rank-Based Private Office Area Space Programming" and Table 6.2.1 "Open Office Space Programming" for workspace minimum and maximum SF allowances.
- 4.5.5 Net Floor Area for administrative areas shall be a maximum of 120 sf/person.
- 4.5.6 Administrative Support Space, which includes conferencing, copier, fax, common filing space, and coffee bars is to be a maximum of 40 sf/person. Included in the 40 sf/person, conferencing space is to be designed to 15-20 sf/person (reference Air Force Manual 32-1084, Table 6.4).
- 4.5.7 Average system furniture or modular workstations are to be based on the following individual standard work spaces (4.5.7.1-4.5.7.7). See AutoCAD file (stdlayout.dwg) for standard configurations/layouts.
 - 4.5.7.1 Standard Workstation - (64 SF maximum) Approx. 76.5% of organization's space. Utilized by non-supervisory personnel.
 - 4.5.7.2 Section Chief Workstation - (80 SF maximum) Approx. 15% of organization's space. Utilized by Supervisors. May be a private office if justified by job description.
 - 4.5.7.3 Flight Chief/First Sergeant Private Office - (120 SF maximum) Approx. 3% of organization's space. Utilized by 4-Ltr Branch Chiefs and Superintendents.
 - 4.5.7.4 Squadron Commander/Deputy Squadron Commander/Flight Commander Private Office - (150 SF maximum) Approx. 4% of organization's space. Utilized by 3-Ltr Division Chiefs, Deputy Division Chiefs, and PhD (Tenured Faculty).
 - 4.5.7.5 Group Commander/Deputy Group Commander Private Office - (250 SF maximum) Approx. 1% of organization's space. Utilized by 2-Ltr Managers.
 - 4.5.7.6 Wing Commander/Deputy Wing Commander Private Office - (350 SF maximum) Approx. .5% of organization's space. Utilized by SES and General Officers.
 - 4.5.7.7 Task Workstation - (25 SF maximum) With prior approval. Utilized by Reservists, Contractors, and students.
- 4.5.8 Special Purpose Space is in addition to Net Floor Area and requires prior approval.

4.6 Standardization

- 4.6.1 Many facility types are required to support the Air Force's varied missions and programs. By standardizing interiors, the design and procurement process is greatly shortened,

enabling the facility engineering staff to respond more quickly to mission changes. Standardizing building interiors also establishes a benchmark of desired results.

- 4.6.2 Once a manufacturer, color, and finish scheme has been established by a large purchase, as much as practical, all future purchases in the organization and/or building are to be the same.
- 4.6.3 In large furniture purchases, all seating with the same function is to have the same fabric, for ease of future reorganizations.



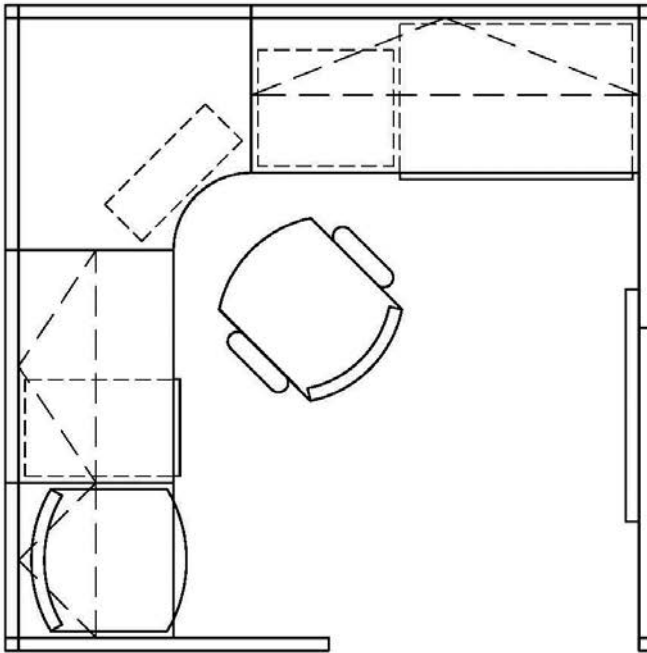
ADMINISTRATIVE WORKSTATION (64 SF max.)

COMPONENTS (EXCLUDING PANELS):

- 1 - 60"x24" WORK SURFACE
- 1 - 36"x24" WORK SURFACE
- 1 - 36"x36" CORNER WORK SURFACE
- 1 - 60"W OVERHEAD STORAGE CABINET
- 1 - 36" TASK LIGHT
- 1 - PENCIL/LAP DRAWER
- 1 - BBF STORAGE PEDESTAL
- 1 - FULLY ADJUSTABLE T-ARM TASK CHAIR

OPTIONAL COMPONENTS:

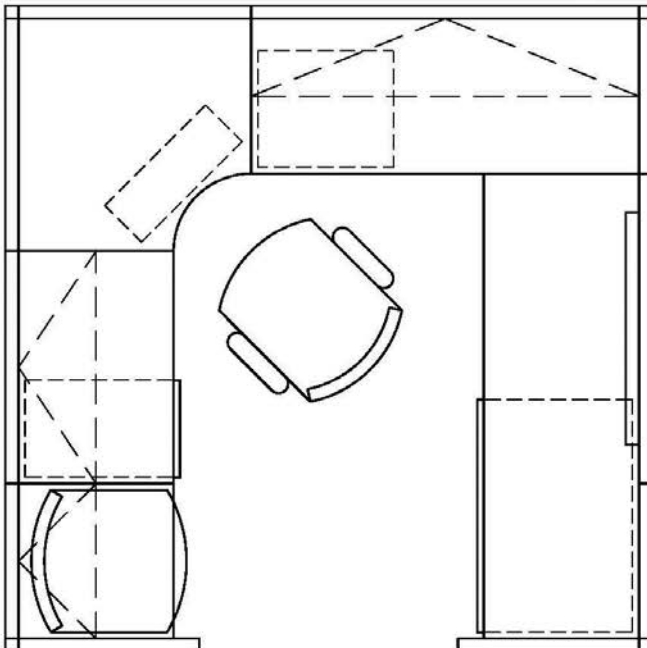
- 1 - 24"x24" STORAGE WARDROBE
- 1 - 24"x24" WORK SURFACE
- 1 - 36"x24"H WHITE MARKER BOARD W/ TRAY
- 1 - FULLY ARTICULATING KEYBOARD TRAY
- 1 - TWO DRAWER LATERAL FILE
- 1 - GUEST CHAIR

**STANDARD WORKSTATION (64 SF max.)****COMPONENTS (EXCLUDING PANELS):**

- 1 - 60"x24" WORK SURFACE
- 1 - 36"x24" WORK SURFACE
- 1 - 36"x36" CORNER WORK SURFACE
- 1 - 60"W OVERHEAD STORAGE CABINET
- 1 - 36"W OVERHEAD STORAGE CABINET
- 1 - 36" TASK LIGHT
- 1 - PENCIL/LAP DRAWER
- 1 - BBF STORAGE PEDESTAL
- 1 - FULLY ADJUSTABLE T-ARM TASK CHAIR

OPTIONAL COMPONENTS:

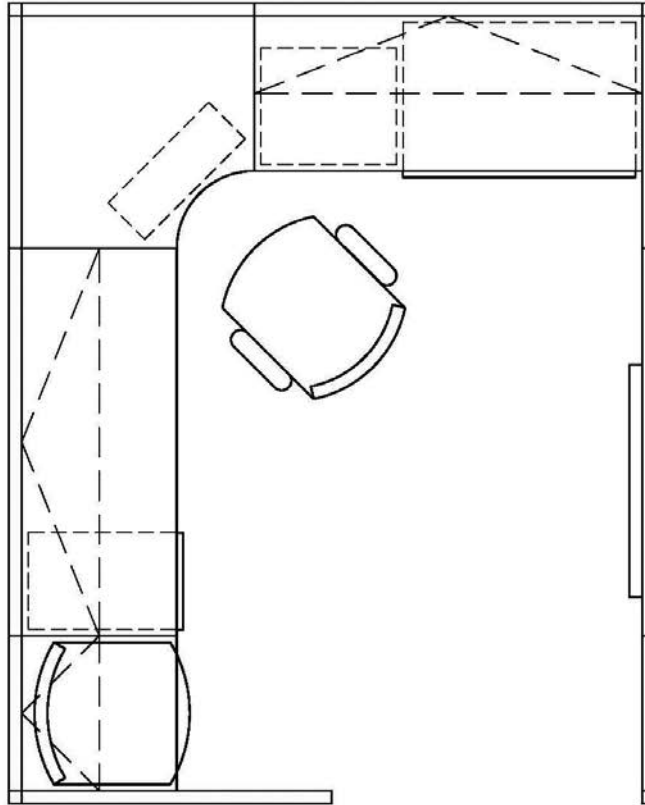
- 1 - 24"x24" STORAGE WARDROBE
- 1 - 24"x24" WORK SURFACE
- 1 - 24"W OVERHEAD STORAGE CABINET
- 1 - 36"x24"H WHITE MARKER BOARD W/ TRAY
- 1 - FULLY ARTICULATING KEYBOARD TRAY
- 1 - TWO DRAWER LATERAL FILE
- 1 - GUEST CHAIR
- 1 - SAFE

**STANDARD WORKSTATION (64 SF max.)****COMPONENTS (EXCLUDING PANELS):**

- 1 - 72"x24" WORK SURFACE
- 1 - 60"x24" WORK SURFACE
- 1 - 36"x24" WORK SURFACE
- 1 - 36"x36" CORNER WORK SURFACE
- 1 - 60"W OVERHEAD STORAGE CABINET
- 1 - 36"W OVERHEAD STORAGE CABINET
- 1 - 36" TASK LIGHT
- 1 - PENCIL/LAP DRAWER
- 1 - BBF STORAGE PEDESTAL
- 1 - TWO DRAWER LATERAL FILE
- 1 - FULLY ADJUSTABLE T-ARM TASK CHAIR

OPTIONAL COMPONENTS:

- 1 - 24"x24" STORAGE WARDROBE
- 1 - 24"x24" WORK SURFACE
- 1 - 24"W OVERHEAD STORAGE CABINET
- 1 - 36"x24"H WHITE MARKER BOARD W/ TRAY
- 1 - FULLY ARTICULATING KEYBOARD TRAY
- 1 - GUEST CHAIR
- 1 - SAFE



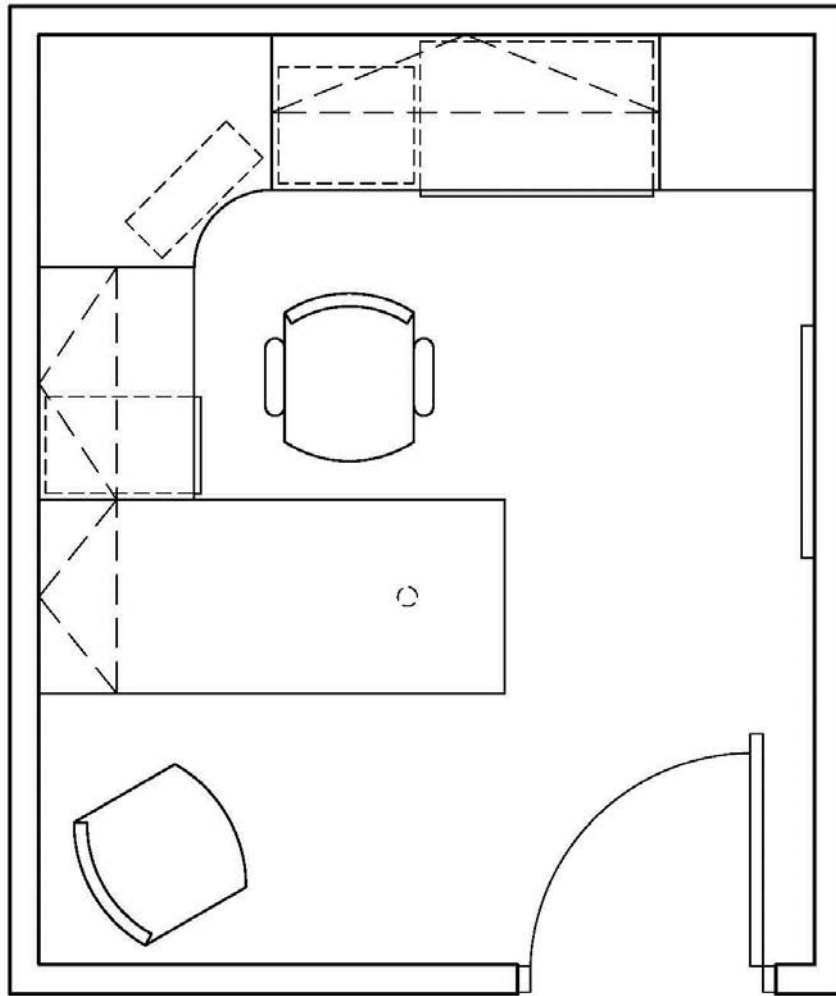
SECTION CHIEF WORKSTATION (80 SF max.)

COMPONENTS (EXCLUDING PANELS):

- 2 - 60"x24" WORK SURFACE
- 1 - 36"x36" CORNER WORK SURFACE
- 2 - 60"W OVERHEAD STORAGE CABINET
- 1 - 36" TASK LIGHT
- 1 - PENCIL/LAP DRAWER
- 1 - BBF STORAGE PEDESTAL
- 1 - TWO DRAWER LATERAL FILE
- 1 - FULLY ADJUSTABLE T-ARM TASK CHAIR

OPTIONAL COMPONENTS:

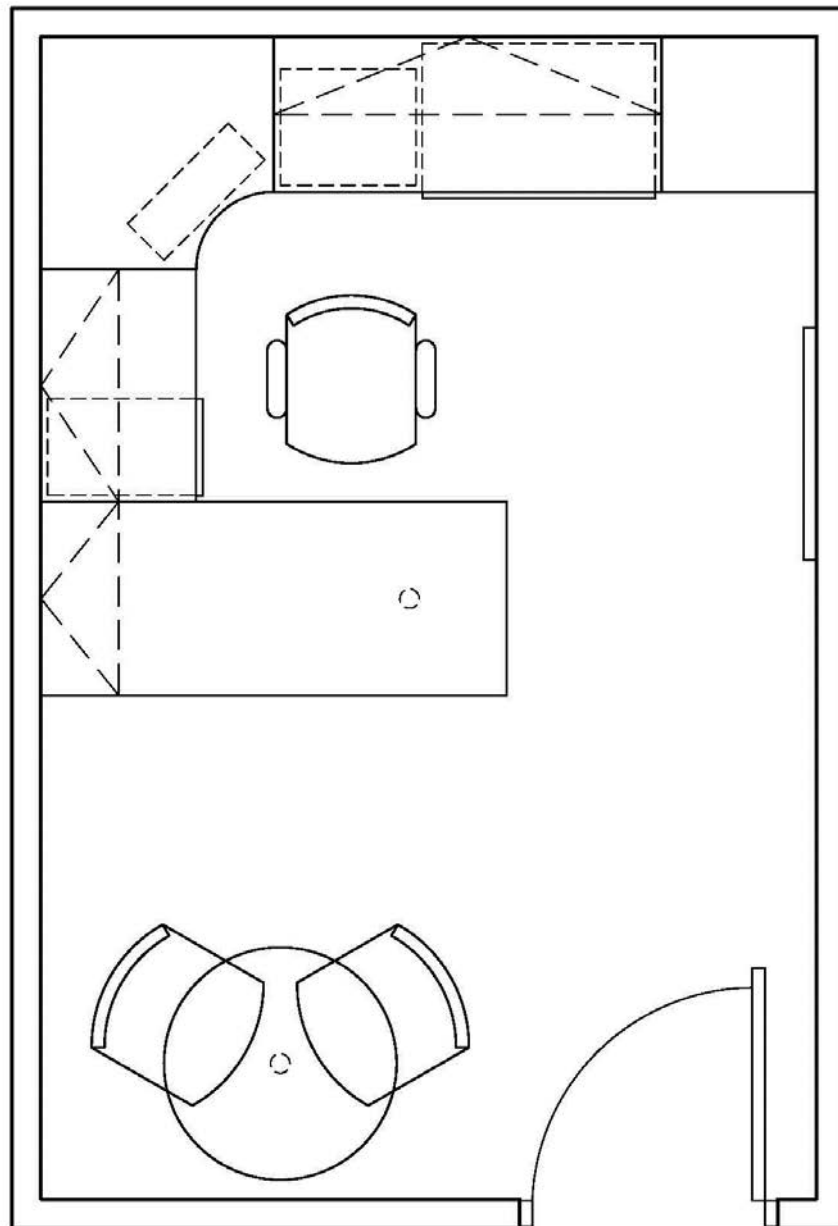
- 1 - 24"x24" WORK SURFACE
- 1 - 24"x24" OVERHEAD STORAGE CABINET
- 1 - 36"x24"H WHITE MARKER BOARD W/ TRAY
- 1 - FULLY ARTICULATING KEYBOARD TRAY
- 1 - GUEST CHAIR



FLIGHT CHIEF/FIRST SERGEANT PRIVATE OFFICE (120 SF max.)

COMPONENTS:

- 1 - 24"x24" STORAGE WARDROBE CABINET
- 1 - 60"x24" WORK SURFACE
- 1 - 36"x24" WORK SURFACE
- 1 - 36"x36" CORNER WORK SURFACE
- 1 - 72"x30" PENINSULA WORK SURFACE
- 1 - 60"W OVERHEAD STORAGE CABINET
- 1 - 36"W OVERHEAD STORAGE CABINET
- 1 - 30"W OVERHEAD STORAGE CABINET
- 1 - 36" TASK LIGHT
- 1 - FULLY ARTICULATING KEYBOARD TRAY
- 1 - PENCIL/LAP DRAWER
- 1 - BBF STORAGE PEDESTAL
- 1 - TWO DRAWER LATERAL FILE
- 1 - 36"x24"H WHITE MARKER BOARD W/ TRAY
- 1 - FULLY ADJUSTABLE T-ARM TASK CHAIR
- 1 - GUEST CHAIR

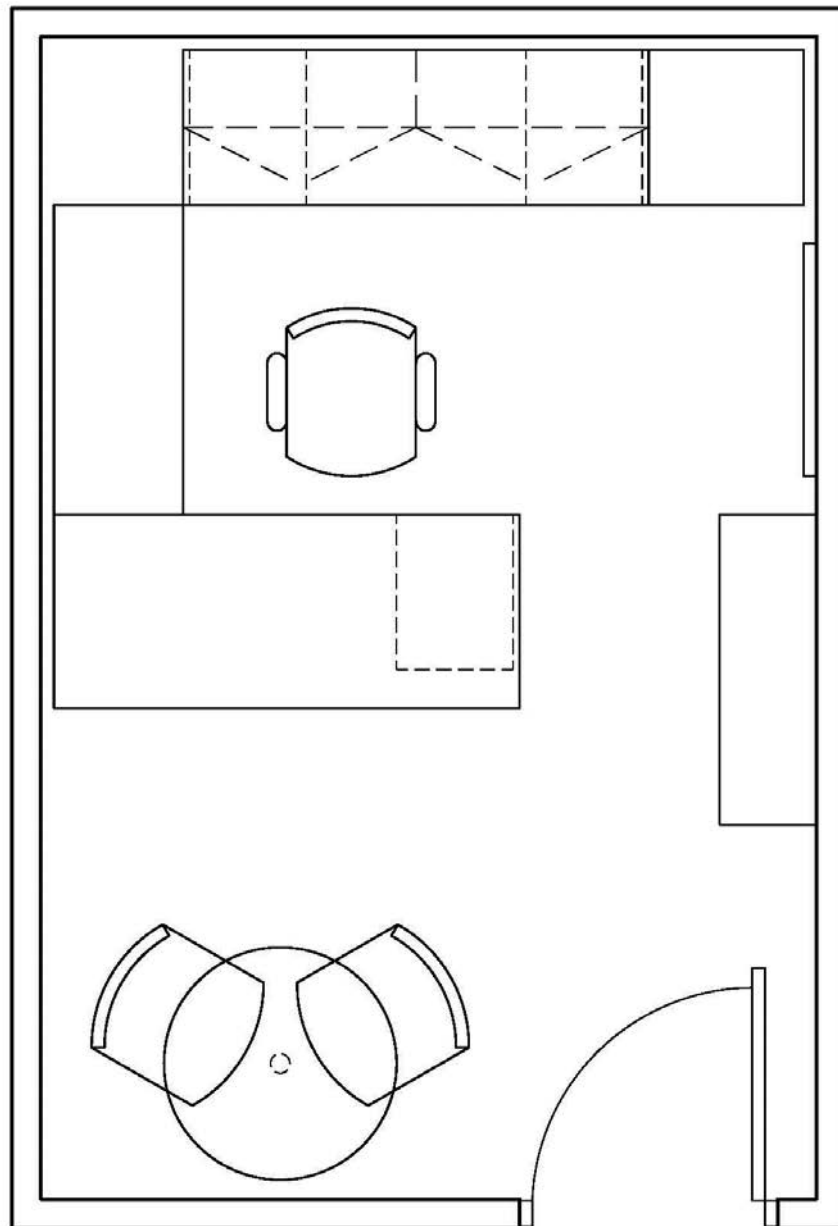


**SQUADRON COMMANDER/DEPUTY/FLIGHT COMMANDER
PRIVATE OFFICE (150 SF max.)**

COMPONENTS:

- 1 - 24"x24" STORAGE WARDROBE CABINET
- 1 - 60"x24" WORK SURFACE
- 1 - 36"x24" WORK SURFACE
- 1 - 36"x36" CORNER WORK SURFACE
- 1 - 72"x30" PENINSULA WORK SURFACE
- 1 - 60"W OVERHEAD STORAGE CABINET
- 1 - 36"W OVERHEAD STORAGE CABINET
- 1 - 36" TASK LIGHT

- 1 - FULLY ARTICULATING KEYBOARD TRAY
- 1 - PENCIL/LAP DRAWER
- 1 - BBF STORAGE PEDESTAL
- 1 - TWO DRAWER LATERAL FILE
- 1 - 36"x24"H WHITE MARKER BOARD W/ TRAY
- 1 - FULLY ADJUSTABLE T-ARM TASK CHAIR
- 2 - GUEST CHAIRS
- 1 - 36"DIA CONFERENCE TABLE W/ METAL "X" BASE

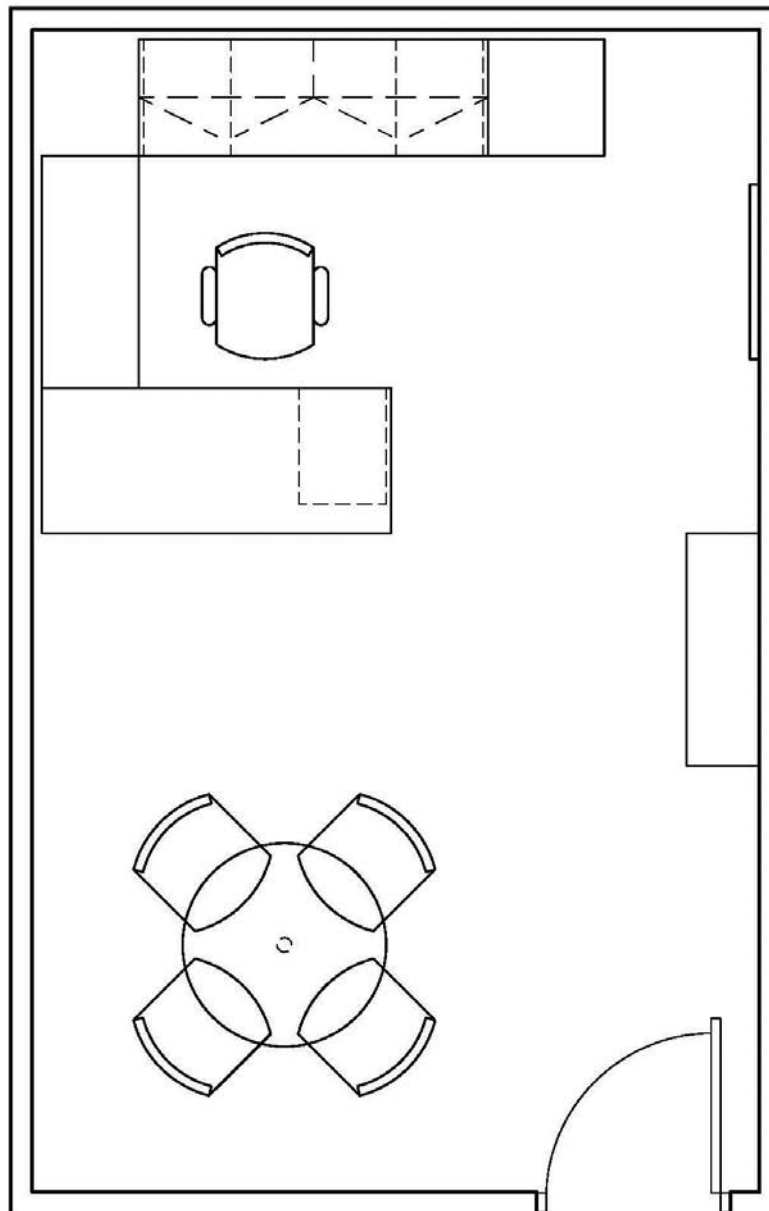


**SQUADRON COMMANDER/DEPUTY/FLIGHT COMMANDER
PRIVATE OFFICE (150 SF max.)**

COMPONENTS:

- 1 - 24"x24" STORAGE WARDROBE CABINET
- 1 - 72"x24" DOUBLE PED CREDENZA W/ OVERHEAD STORAGE CABINET
- 1 - 72"x30" SINGLE PED MODULAR DESK
- 1 - 48"x20" MODULAR RETURN
- 1 - FULLY ARTICULATING KEYBOARD TRAY
- 1 - 48"W FOUR-SHELF BOOKCASE
- 1 - 36"x24"H WHITE MARKER BOARD W/ TRAY

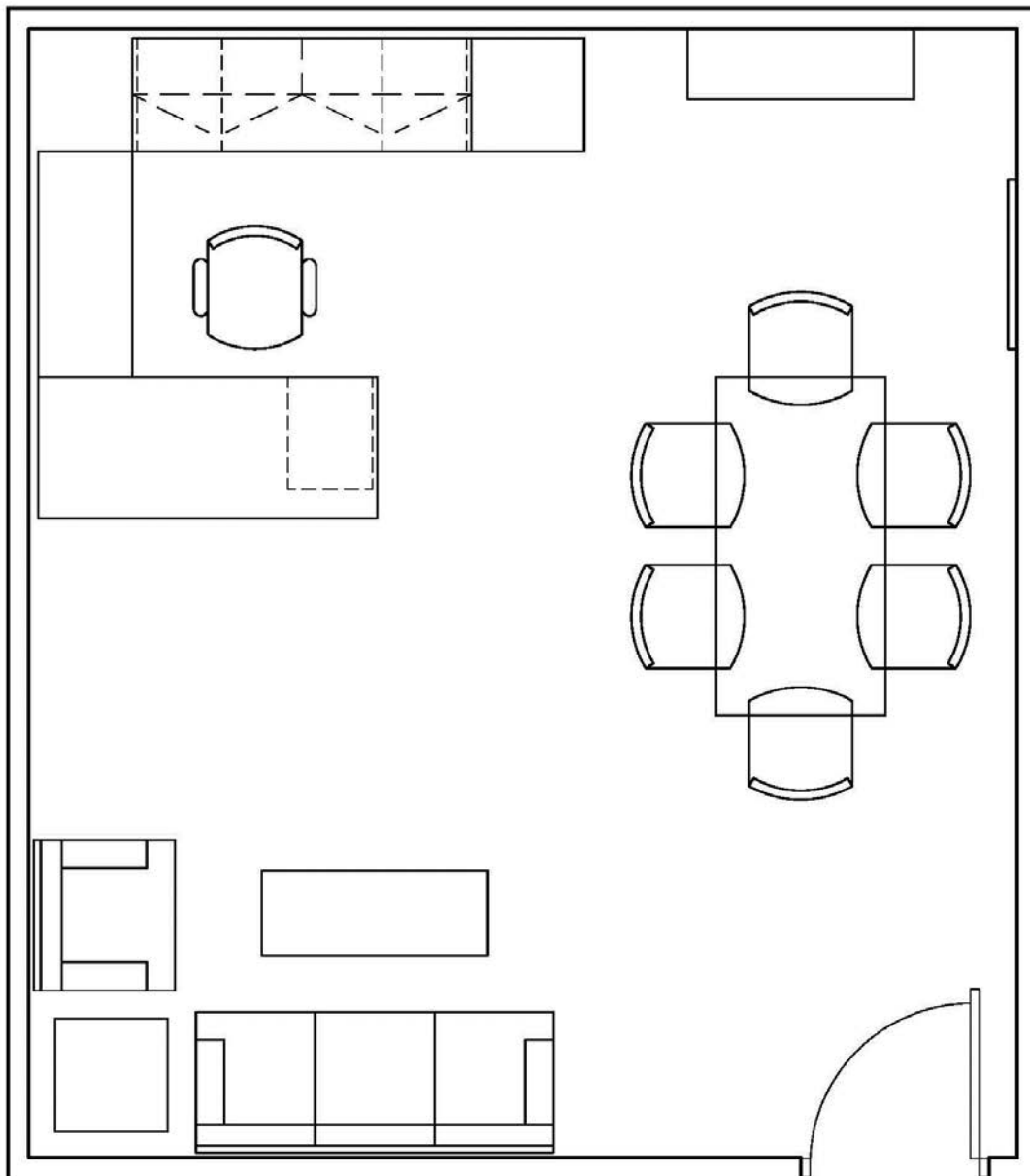
- 1 - FULLY ADJUSTABLE T-ARM TASK CHAIR
- 2 - GUEST CHAIRS
- 1 - 36"DIA CONFERENCE TABLE W/ METAL "X" BASE



GROUP COMMANDER/DEPUTY PRIVATE OFFICE (250 SF max.)

COMPONENTS:

- 1 - 24"x24" STORAGE WARDROBE CABINET
- 1 - 72"x24" DOUBLE PED CREDENZA W/ OVERHEAD STORAGE CABINET
- 1 - 72"x30" SINGLE PED MODULAR DESK
- 1 - 48"x20" MODULAR RETURN
- 1 - FULLY ARTICULATING KEYBOARD TRAY
- 1 - 48"W FOUR-SHELF BOOKCASE
- 1 - 36"x24"H WHITE MARKER BOARD W/ TRAY
- 1 - FULLY ADJUSTABLE T-ARM TASK CHAIR
- 4 - GUEST CHAIRS
- 1 - 42"DIA CONFERENCE TABLE W/ METAL "X" BASE



WING COMMANDER/DEPUTY PRIVATE OFFICE (350 SF max.)

COMPONENTS:

- | | |
|---|------------------------------|
| 1 - 24"x24" STORAGE WARDROBE CABINET | 1 - 72"x36" CONFERENCE TABLE |
| 1 - 72"x24" DOUBLE PED CREDENZA W/ OVERHEAD STORAGE CABINET | 1 - 84" SOFA |
| 1 - 72"x30" SINGLE PED MODULAR DESK | 1 - OCCASIONAL CHAIR |
| 1 - 48"x20" MODULAR RETURN | 1 - COFFEE TABLE |
| 1 - FULLY ARTICULATING KEYBOARD TRAY | 1 - END TABLE |
| 1 - 48"W FOUR-SHELF BOOKCASE | |
| 1 - 36"x24"H WHITE MARKER BOARD W/ TRAY | |
| 1 - FULLY ADJUSTABLE EXECUTIVE DESK CHAIR | |
| 6 - CASTERED CONFERENCE CHAIRS | |

Facility XXXXX, Interior Signage Qty and Wording

ITEM #	SIGN TYPE	QTY	DRWG RM #	LINE 1 TEXT	LINE 2 TEXT	LINE 3 TEXT	LINE 4 TEXT	LOCATION/REMARKS
	I-1			WOMEN OR MEN	(graphics)	n/a	n/a	At Entry Door
	I-2			(room number)	(office name)	(office symbol)	n/a	At Entry Door
	I-3			(room number)	(office name)	(occupant's name, 1 st initial & last name)	n/a	At Entry Door
	I-4			(room number)	CONFERENCE ROOM	Available/In Use	n/a	At Entry Door
	I-5			NOTICE	IN CASE OF FIRE USE STAIRS	(graphic)	DO NOT USE ELEVATOR	At Elevator Entry
	I-6			FIRST FLOOR	(see attached spreadsheet on wording)			Near Rm
	I-7			Name, In-Out, Comments	n/a	n/a	n/a	At Workstation #
	I-8			(office name)	n/a	n/a	n/a	At Workstation #
	I-9			(workstation #)	(occupant's name, 1 st initial & last name)	(position title)	n/a	At Workstation #
	I-10			(room number)	(see attached spreadsheet on wording)			At Workstation #
	I-11			(Facility XXXXX)	(see attached spreadsheet on wording)			Lobby
	I-12			(Stair X)	(graphics)	n/a	n/a	At Entry Door
	I-13			FIRE EXTINGUISHER	(graphics)	n/a	n/a	At Box Location
	I-14			(Facility XXXXX)	n/a	n/a	n/a	At Entry Door
	I-15			n/a	n/a	n/a	n/a	At Entry Door

Each individual sign is to have a line in the spreadsheet, stating the text to be printed.

5.0 CIVIL/STRUCTURAL

5.1 Sanitary Sewer System

5.1.1 System Description

Wastewater is collected via a system of trunk lines, branches, laterals and force mains. The majority of Area A wastewater drains by gravity to a main lift station, (Bldg. 117). From there it is pumped up over Huffman Dam and continues by gravity to the City of Dayton Wastewater Treatment Plant (WWTP). The second main trunk in Area A services the West Ramp and Bldg. 22 areas. This trunk consists of twin 380mm (15-inch) lines (north trunk) that drain by gravity from Fairborn through the Base to the City of Fairborn's WWTP. The flight line area of Area A drains to a small lift station, Bldg. 56, which discharges the wastewater into sewer mains feeding into Bldg. 117.

The south western part of Area A drains to a small lift station, Bldg. 1440, which forces the wastewater into the discharge force main which starts at Bldg. 117 and ends at Huffman Dam. The central part of Area A drains to a small lift station that lifts wastewater to the gravity main that drains to the Bldg. 117 lift station.

All of the Area B wastewater drains by gravity to the City of Dayton WWTP. Generally the upper (eastern) section of Area B drains into the gravity line coming from Area A, and the lower (western) section of Area B drains into a separate smaller line that flows to the Dayton WWTP.

Woods housing area wastewater is pumped via Bldg. 7000 lift station into the Bldg. 117 force main. Prairies housing area wastewater flows to the City of Dayton WWTP via two routes.

5.1.2 General Conditions

In general, most sewers experience normal inflow/infiltration (I/I) problems in some cases leading to lack of capacity. These low capacity areas are indicated in the 1974 Dalton, Dalton, Little & Newport report, which is available for review in the Base Civil Engineer's office. The Dalton report also lists existing flows and remaining capacity in all of the trunk lines and branches. Architectural/Engineering (A/E) firms shall contact the Base Water/Sanitary/Waste Treatment Engineer for updated information on sanitary systems.

WPAFB operates a separate sanitary and storm sewer system. In no case should a project be designed using combined sewers. At present, WPAFB has no centralized industrial wastewater collection or treatment system. The extent of "industrial treatment" is specific site treatment at plating shops, heating plants, etc., prior to discharge into the sanitary sewer system. Oil separators are located throughout the Base at sites requiring their use.

5.1.3 Sewer Material/Installation

In general, existing sanitary sewers are vitrified clay, cast iron or PVC pipe. In some cases, usually larger lines, existing sewers are reinforced concrete pipe. Current industry standards shall be used when designing sanitary sewer systems. Unless otherwise approved, new pipe material shall be vitrified clay or smooth wall interior and exterior, ASTM D 3034, SDR 35 PVC. Mandrel testing is required for all new PVC mains. Testing shall be completed no sooner than 30 days after final backfill and shall include hand pulling a mandrel of no less than 95% of the base inside diameter through the pipe. All areas where the mandrel does not pass shall be replaced.

Because various types of pipes are used throughout the Base, designers are strongly encouraged to conduct thorough field investigation to verify existing pipe materials and installations.

Manholes shall be provided at all junctions, change of direction, and change in pipe size locations. Pipe run between manholes shall be at a constant grade at sufficient slope to provide a minimum velocity of 2.0 feet per second (fps) at full or half full flow. Standard manholes shall be pre-cast 48 inch diameter concrete with Neenah R-1767 casting, vented with 4 each pick-holes.

5.1.4 Permitting

All new sources of non-domestic waste that will enter the Base sanitary sewer systems must be approved. Also, all significant changes or additions to the sanitary sewer system itself shall require an Ohio EPA Permit to Install. Permitting and approval requirements shall be coordinated through the Base Installation Management Division, Environmental Branch (88 CEG/CEIE). The design A/E shall be responsible to prepare all required permit applications and submit them to 88 CEG/CEIE for forwarding to the appropriate regulatory authority. Preparations may include providing a check for the cost of the permit application. Additional environmental requirements are described in Section 6.

5.1.5 Removals

Where existing laterals are disconnected or abandoned, the tee or tap in the main shall be removed and replaced with a straight section of pipe. Replacement pipe shall be of same type and material as the main. Exposed end of lateral shall be capped and sealed water tight.

5.2 Water System

5.2.1 System Description

Water for WPAFB is supplied by Base owned and operated wells and is distributed through a system of water mains, pump stations, elevated storage tanks, and reservoirs:

- North Area A (old Area C) and the West Ramp are supplied by Wells #1, 2, 3, and 7 via the Bldg. 172 pump station and the North Area A and West Ramp elevated water towers.
- South Area A is supplied by Wells 8 and 9 via the Bldg. 855 pump station and the South Area A elevated water tower along Newark Street and Communication Boulevard. The Area A North- and South- systems can be connected together by opening isolation valves at Bldg. 855.
- Area B is supplied by Wells #1, 2A, 2B, 4 and 5 located along Springfield Street, and, if necessary, can be supplied by Wells A, B, E and F located by Gravel Lake. The Area B distribution system is divided into the "high" and "low" sections. The "high" section (generally the area above "K" Street) is supplied via the Bldg. 85A pump station and the "hilltop" elevated water tower along Tenth and "Q" Streets. The "low" section is supplied by gravity from the reservoirs located at Bldg. 85A and by the twin water towers along Skyline Drive and Eighth Street.
- Prairies housing is supplied with water purchased from Montgomery County.

Treatment consists of chlorination, polyphosphate injection, carbon dioxide injection, air stripping, and fluoridation. Water for the housing areas and certain buildings in Kittyhawk Center is softened. Various buildings (heating plant, labs, etc.) have their own treatment system as required for their particular operations.

Except for the flight line area, the potable and fire protection systems are tied into the same distribution mains. Well system capacities are sufficient to meet all anticipated demands.

- 5.2.2 **NOTE:** All connections to the Government water system, either through direct connection to piping or via fire hydrants, shall be equipped with a reduced pressure principle backflow device approved for use by the Ohio Environmental Protection Agency (EPA) for public water supply. On all water laterals entering a facility, a reduced pressure principle backflow device shall be installed within 36 inches from where the lateral enters the facility. Utilize reduced pressure principle backflow manufacturers Wilkens, for sizes ½" to 2", or WATTS for all sizes. Where space or other considerations do not allow installation of the device within this 36 inches then the device shall be installed in a heated "hot box" just outside the facility.

- 5.2.2.1 All facility potable water service entrances shall include a standard water meter with analog readout along with a digital output compatible with the Base EMC system for remote reading. Meter digital output shall be connected and configured as reference in Section 7.6.3.3.

5.2.3 Water Line Material/Installation

In general, existing water mains (primary and secondary feeder lines) are ductile iron or PVC rated at 1 Mpa (150 psi). Current industry standards and Ohio EPA requirements shall be used when designing water distribution systems. Because various types of pipes

are used throughout the Base, designers are strongly encouraged to conduct thorough field investigations to verify existing pipe materials and installations. All water mains should be designed with a 1.2-meter (4 foot) minimum cover and be rated at a minimum of 150 pounds per square inch (psi). Unless otherwise approved, new pipe material shall be: ductile iron Class 52, or AWWA C 900 PVC, DR 18 with ductile iron fittings for pipes 4 inches in size and larger; ASTM D 2241, SDR 26, PVC rated at 160 psi for pipes 2 inch to 4 inch in size; and ASTM D 1785, Schedule 40, PVC or Type K copper for pipes less than 2 inches in size.

Location of all mains shall meet Ohio EPA requirements, including minimum 18 inch vertical separation (outside to outside) and minimum 10 foot horizontal separation (outside to outside) from sanitary and storm sewers. Preference is to have water line on top. All new mains and laterals shall be disinfected in accordance with American Water Works Association (AWWA) Standard AWWA C651-05 including the optional procedures listed in Section 4.3.9 Backflow Protection and Section 4.6 Final Connections to Existing Mains.

Main gate valves shall be AWWA C 509 resilient wedge, open left counter-clockwise. Valve boxes shall be cast iron. All valve boxes shall have an 8 inch concrete collar set at grade when placed in pavement. Fire hydrants shall be Mueller Centurion or equal, open left counter-clockwise, with National Standard threads and integral 5" Storz connection.

Connections to existing piping shall be with a "tee" fitting. Tapping will only be allowed with prior approval. Valves shall be provided on each leg of a tee and at every 500 linear feet along pipe runs.

Coordination with the Base Water Department shall be made a minimum of 14 days prior to all water outages. Water outages of 4 hours or more shall be made after normal duty hours or on the weekend.

5.2.4 Permitting

All major modifications to the Base water systems must have Ohio EPA plan approvals. Approval requirements shall be coordinated through the Base Environmental Branch. The design A/E shall be responsible to prepare all required permit applications and submit them to 88 CEG/CEIE for forwarding to the appropriate regulatory authority. Preparations may include providing a check for the cost of the permit application. Additional environmental requirements are described in Section 6.

5.2.5 Removals

Where existing laterals are disconnected or abandoned, the tee or tap in the main shall be removed and replaced with a straight section of pipe. Replacement pipe shall be of same type and material as the main. Exposed end of lateral shall be capped and sealed water tight.

5.3 Storm Sewer System

5.3.1 System Description

Storm drainage for Area A flows into the Mad River via Hebble Creek or through twin 1.2 meter (48-inch) pipes crossing the north end of the runway. Drainage for Area B flows to the Mad River via four separate outfalls.

Due to the high concentration of built-up areas and under-designed pipelines, there are many sections of the Base that experience minor to major flooding during storm events. As new development continues, sections subjected to flooding must be evaluated for capacity before any new storm runoff is introduced.

5.3.2 Design Requirements

All designs shall incorporate and be responsible to identify design requirements IAW Section 438 of the Energy Independence and Security Act (EISA) and gain approval from the Base Civil Engineering Division, and Installation Management Environmental Section. See Section 6.16 for additional information.

5.3.3 Permits

Permits may be required for discharges into storm sewers and/or for erosion control (particularly on construction sites of one acre or more). Erosion and sediment controls shall be incorporated into all construction projects. The design A/E shall be responsible to prepare all required permit applications and submit them to 88 CEG/CEIEA for forwarding to the appropriate regulatory authority.

5.3.4 Pipe Materials/Installation

In general, existing storm sewers are reinforced concrete pipe, corrugated metal pipe, or PVC pipe. Current industry standards shall be used when designing storm sewer systems. Unless otherwise approved, new pipe material shall be reinforced concrete or smooth wall interior and exterior ASTM D 3034, SDR 35 PVC. Corrugated plastic pipe is allowed only for 4 inch, 6 inch, or 8 inch sub drain piping. Corrugated metal pipe is allowed only as culvert pipe under driveways.

WPAFB standard drainage structures are as follows: Curb inlet – Type “Y” box with Neenah R-3246-CL casting; Surface inlet – Type “E” box with Neenah R-3408-AL casting; Lawn inlet – Type 2-2B box with heavy duty casting; Manholes – Pre-cast 48 inch diameter concrete with Neenah R-1767 casting, vented with 4 each pick-holes. All drainage castings shall be marked “Dump No Waste. Drains To Waterways.”

5.3.5 Removals

Where existing laterals are disconnected or abandoned, the tee or tap in the main shall be removed and replaced with a straight section of pipe. Replacement pipe shall be of same type and material as the main. Exposed end of lateral shall be capped and sealed water tight.

5.4 Airfield

5.4.1 Airfield Pavement

5.4.1.1 General Description

Patterson Field (KFFO) is located in Area A, and Wright Field in Area B. Patterson Field is the only active airfield at WPAFB. Various documents such as the Pavement Condition Index Survey Report, Structural Pavement Evaluation, Runway Friction Characteristics Evaluation, and as-built drawings are available for designer use.

Patterson Field has nearly 333 acres of pavement and consists of two runways, Rwy 05L-23R (long) and Rwy 05R-23L (short). Rwy 05L-23R is 300' wide and 12,600' long and consists of nearly 60 lane miles of pavement.

Existing airfield pavement consists of asphalt-overlaid concrete, tar-rubber asphalt-overlaid concrete, and concrete. Tar-rubber asphalt is not considered a hazardous material, but does require the use of protective equipment for personnel involved with the removal process if it is being milled or heated in some fashion. Contact a certified Industrial Hygienist for testing and recommendations for pavement sections that have tar-rubber asphalt.

Existing airfield pavement varies in thickness from 2" to 27" or more. Detailed pavement information is available from the Airfield Pavement Engineer.

5.4.1.2 Design Considerations

Airfield pavement shall be designed for mixed traffic - medium load. UFC 3-260-02 Pavement Design for Airfields shall be used for pavement design. Poor pockets of soil are frequently encountered on Patterson Field. As a result, all subgrade soil shall be chemically stabilized for full-depth reconstruction projects to at least 4' beyond the outermost paved surface.

Generally speaking, Patterson Field was constructed on swamp ground and has a relatively high water table with some of the highest producing water wells in the region. Due care shall be taken in the design of an effective drainage system.

Subsurface drainage shall be designed for all pavements in accordance with UFC 3-230-06A Subsurface Drainage.

For asphalt projects, the Ohio Department of Transportation typically uses an asphalt binder of PG 64-22. However, other binders such as 64-28, 70-22, and 76-22 are typically available. Per UFGS 32 12 15.13, designer note in section 2.2 Asphalt Cement Binder, it states, "...grade "bumping" should be applied for the top 125mm (5") of paving in the end of runway and taxiway areas: for aircraft tire pressure between 0.7 and 1.4 MPa (100 and 200 psi), increase the high temperature one grade; for aircraft tire pressure greater than 1.4 MPa (200 psi), increase the high temperature two grades." Therefore, a minimum asphalt binder of PG 70-22 has been established for use in airfield pavements. However, designers are still required to select an appropriate binder to satisfy the specifications.

In consideration for asphalt binder selection, the following climatic data has been provided and is current as of Jan 2014, and was provided by the Air Force Combat Climatology Center in Ashville, NC, 14th Weather Squadron. For ambient air temperatures, the highest 5 consecutive day's average is 37.7°C/99.8°F from 6 – 10 Jul 1988, and the coldest single day on record was 19 Jan 1994 at -28.9°C/-20.0°F.

It should be noted that on asphalt projects, airfield operations will need to be modified for the first year or two during summer months with high temperatures due to the "tenderness" of the new asphalt pavement. Generally speaking, this is when the internal pavement temperature is approximately 120°F or the ambient air temperature is around 90°F. If operations are not modified, the surface of the pavement will be damaged in the form of Mix Scuffing by turning aircraft causing a high Foreign Object Debris (FOD) risk. The Designer of Record (DOR) shall contact the Airfield Manager during the design phase of the project to inform of the needed operation change for post-construction operations.

5.4.2 Temporary (Construction) Waivers and Free-zone Letters

For work inside the airfield perimeter fence, a Temporary (Construction) Wavier and Free Zone letter may be required. For work involving a crane anywhere on Base, a construction wavier may be required, depending on the height of the obstruction. Also, if the height of the obstruction is 200' or more, an FAA Form 7460-1 will be required. These documents can take 60 days or more to process.

5.4.3 Pavement Markings

Airfield pavement marking paint shall conform to Federal Specification TT-P-1952E, Type III for increased durability.

Visual flight rules (VFR) Hold Line markings shall be in accordance with FAA AC 150/5340-1 Standard for Airport Markings (current edition).

5.4.4 Signage and NAVAIDS

For all ground mounted signs and NAVAID installation in grassed areas, extend the concrete pad a minimum of 3' beyond all faces to prevent damage from mowing operations.

5.5 Roadway and Traffic Considerations

5.5.1 Traffic Signs

All signs must comply with the WPAFB Sign Standards. Traffic signs on Base shall conform to the standards put forth in the Manual on Uniform Traffic Control Devices (MUTCD). 88 CEG/CENMP is responsible for approval of all traffic control signs. 88 CES/CEOHS Structures is the accountable authority for the maintenance of all traffic signs on WPAFB. Sign colors used on Base for the message, sign backs, and posts must conform to the WPAFB Sign Standards and the Base color palette.

Sign Specifications:

- Brown Backing - 3M pressure sensitive Deep Mahogany Brown reflective sheeting 48" x 50yd roll P/N 3439
- Sign Front - Gerber Scientific Products Inc. White Scotchcal Vinyl 15" x 30" roll P/N P20854C
- Letters - Gerber Scientific Products Inc. Terracotta Spot Foil P/N P66264A

Post Specifications:

- Quick-Punch Square Sign Post 2"x2 (14) Gauge Power Coated "Brown"
- Traffic signs will meet height requirements as stated in the MUTCD
- Reserved parking signs will be mounted at a height of 4' to the bottom of the sign

5.5.2 Parking

Parking on WPAFB is regulated according to WPAFBI 31-204 and the Ohio Revised Code (ORC). Base Security Forces (88 SFS) is the authority for assigning reserved parking spaces based on requirements according to WPAFBI 31-204.

- Handicapped parking spaces shall match the Uniform Federal Accessibility Standards and comply with the Architectural Barriers Act Accessibility Standards (ABA).

5.5.3 Curbing Standards

Questions regarding type, style and locations of curbs, curb cuts and handicapped accessible curbs can be directed to 88 CEG/CENMP.

- The Base standard is a 610mm (24 inch) curb and gutter unless existing site conditions require compatibility with existing curb and gutter.
- Handicapped accessible curbs shall conform to the Uniform Federal Accessibility Standards and comply with the Architectural Barriers Act Accessibility Standards (ABA).

5.5.4 Pavement

5.5.4.1 General Description

Existing roads are asphalt or asphalt overlaid concrete.

5.5.4.2 Design Considerations

UFC 3-250-01FA Pavement Design for Roads, Streets, Walks, and Open Storage Areas shall be used for pavement design. UFC documents are available at <http://www.wbdg.org/>. Subsurface drainage shall be designed for all pavements in accordance with UFC 3-230-06A Subsurface Drainage.

Other forms of reference material available for user are the Ohio Department of Transportation's (ODOT) Pavement Design Manual and the Construction and Materials Specifications (CMS), available on their Design Reference Resource Center website <http://www.dot.state.oh.us/drrc/Pages/default.aspx#>. This will provide specific information pertaining to paving materials available from ODOT certified suppliers. Also, note that the typical asphalt binder used by ODOT is PG 64-22. However, other binders are readily available.

5.6 Structural

Every building, similar structure and portion thereof shall be designed and constructed to resist the effects of ground motions as prescribed by the IBC provisions of section 1613 through 1623 and section 9.0 of SEI /ASCE 7-02 of the ASCE Standard.

Earthquake hazard shall be moderate at WPAFB; the specified (design) ground motion for the installation shall be moderate destructive event.

The minimum performance level for all AFMC buildings is life safety with 10% probability of exceedance in 50 years. The specified ground motion shall be represented by a 5% damped acceleration response spectrum having a 500 year recurrence rate.

Seismic use group III includes:

- IIIE for mission essential, sensitive munitions, weapons storage, POL, gas, and CBA facilities.
- IIHH for hazardous facilities containing quantities of toxic or explosive substances considered to be dangerous to the general public.

Refer to table 4-1 on UFC 3-310-03A for the performance objectives, Seismic Design Categories, and acceptance criteria of each Seismic Use Group (SUG).

5.7 Soil and Subsurface Investigation

5.7.1 The Architect/Engineer (A/E) shall be responsible to perform all soil borings and investigations required to design the project properly. The designer shall obtain a Base Civil Engineering Work Clearance Request (AF Form 103), completed and signed, prior to beginning any and all digging, boring, trenching, etc. This form must be present at the job site during the work.

To obtain an AF Form 103, the A/E shall clearly and completely mark all locations where borings are to be taken prior to requesting a clearance. These locations shall be clearly numbered or identified in some manner. The designer shall also submit a map to the Base Civil Engineering point of contact showing numbered locations of the borings. The map alone is not acceptable. At least a 14 calendar days' notice is required to obtain a completed AF Form 103.

A representative of the A/E is encouraged to attend the clearance meeting. If a conflict occurs concerning boring locations, they can easily be moved by the representative, and cleared on site. Another meeting is required to clear relocated points if the A/E is not present.

5.7.2 Detailed soil investigations are important due to the following conditions:

- Rock, as shallow as one meter (4'), is common in the higher elevations of Area B.
- A shallow water table is present in several areas of Area A, especially the flight line area.

5.8 Soil Treatment

Termite treatments shall be included in all new construction and major renovation projects. Ensure all projects are coordinated through the Base Entomologist for review during the design phase. Use only non-repellent termiticide in accordance with Unified Facilities Guide Specification (UFGS) 31 31 16, Soil Treatment for Subterranean Termite Control, applied at the highest EPA-labeled concentration and application rate, in accordance with AFI 32-1053 and

DoDI 4150.07 Paragraph E4.6. All termite treatments shall be performed by properly licensed and current in category applicators. Base Entomology (257-3593) shall be notified when treatments begin for QAE (quality assurance evaluation). All records of applications shall be turned over to Base Entomology for recording chemical amounts and processes.

6.0 ENVIRONMENTAL

6.1 Specifications, Permits, and Environmental Surveys

- 6.1.1 Background: All environmental work shall be conducted in accordance with WPAFB specification section 01 02 20 and all other applicable specification sections as well as all federal, state and local regulations that are in effect at the time the work is to be accomplished.
- 6.1.2 Action: When federal, state, or local environmental permits are required for a project (e.g., Ohio Environmental Protection Agency (EPA) Permits to Install and Operate), the Architect/Engineer (A/E) shall be responsible for preparing complete permit applications (except in cases that require a permit to be prepared by 88 CEG/CEIE such as in para 6.3), including any required attachments or supporting documents. These permit applications are to be submitted to the Base Environmental Branch, 88 CEG/CEIE, for processing by the appropriate regulatory authority.
- 6.1.3 Action: The A/E is responsible for ensuring a comprehensive environmental survey for the (demolition/renovation) is included as part of the design. The survey shall identify the presence of toxic, hazardous, and other regulated substances including items that contain mercury (switches, thermostats, lamps), PCBs (light ballasts, transformers), lead (paint) halons (fire suppression equipment), as well as spills and building components that contain these substances. In addition, the survey shall include exit signs and emergency lighting (mercury lamps and batteries) and smoke detectors (radioactive material). In laboratories, hospitals, or other research facilities where metallic hood systems or sink traps are to be removed during remodeling or demolition, the survey shall encompass testing these units, including chemical testing where applicable, to determine if a potentially shock sensitive or explosive situation exists. Also in these types of facilities, the survey should include determining the presence of liquid mercury in sink traps, traps under floor drains, and in concrete seams/cracks. In all facilities, the presence or absence of abandoned hazardous materials (e.g., gas cylinders, paints, spray cans, fuels, etc...) shall be determined by visual inspection as part of the survey. This includes fire extinguishers. If hazardous chemicals are found to exist, the Environmental Branch (88 CEG/CEIE) shall be notified immediately (257-5531 or 257-7152).
- 6.1.4 Action: A thorough asbestos survey shall be performed in compliance with §40CFR 61.145 and OAC 3745-20-02. This asbestos survey shall meet, as a minimum, the standards set forth in ASTM E2356-10 Section 8. If for any reason these survey requirements cannot be met; i.e. because of occupancy or inaccessibility, contact 88CEG/CEIE at 257-9049.

6.2 Air Quality

6.2.1 Air Pollution

6.2.1.1 Background: Ohio Administrative Code (OAC) 3745-31-02 requires a Permit to Install for any new air contaminant source, unless that source is exempted by OAC 3745-31-03. Additionally, the U.S. EPA finalized rules titled Mandatory Reporting of Greenhouse Gases Rule (40 CFR 98).

6.2.1.2 Action: Upon initiation of any project, the designer shall coordinate with the Environmental Branch Air Program Manager (Air PM), 88 CEG/CEIEA, to determine air contaminant emission permit requirements. If a permit-to-install is required, then the designer shall be responsible for providing necessary information as requested by the Air PM to complete the permit application. The Air PM will submit the application to the regulatory agency. Air Permitting guidance may be obtained by contacting the Air PM (257-2455 or 257-5536).

6.2.1.3 Action: WPAFB is required to maintain a database of Greenhouse Gas (GHG) sources emitted from the Base. The list includes carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), and sulfur hexafluoride (SF₆). In addition, all organizations will be required to maintain a list of GHG sources and the quantity of gas emitted to the atmosphere. Upon initiation of any project that will include GHG sources (such as boilers, incinerators, and generators), the designer shall coordinate with the Air PM to evaluate the impact to the project and installation.

6.2.1.4 Action: Any stationary combustion engine installed must meet the application emissions standards and fuel requirements as outlined in New Source Performance Standards 40 CFR 60, Subpart IIII (compression ignition) or Subpart JJJJ (spark ignition).

6.2.2 Stratospheric Ozone

6.2.2.1 Background: Regulations promulgated in Title VI (Title 40 CFR Part 82) were enacted to implement the *Montreal Protocol on Substances that Deplete the Ozone Layer* and sections of the Clean Air Act Amendments. In addition to control of these compounds, the regulation imposes production, importation, and consumption limits with an eventual production phase-out of ozone depleting substances (ODSs). Production limits were imposed on manufacturers, importers, and exporters of ODSs and thus do not directly affect Air Force activities. However, new rules have been promulgated by U.S. EPA, including an accelerated phase-out of Class II ODSs (U.S.C. 7671e).

6.2.2.2 Action: No project may use any Class I ODS for refrigeration or comfort cooling. All plans to use Class I ODSs shall be coordinated with the Air PM (257-2455 or

257-5536). Maintenance of existing equipment may continue to use available stocks of HCFC (Class II).

6.2.2.3 Action: All Class I ODSs, including halons, chlorofluorocarbon (CFC) refrigerants, carbon tetrachloride and methyl chloroform, taken out of service shall be identified in the environmental survey and returned to the DLA ODS Bank in Virginia IAW WPAFB specification 02 09 10.

6.2.2.4 Action: It is prohibited by AFI 32-7086 Section 4.2 to procure facility systems scheduled to remain in the Air Force inventory beyond 1 January 2020 that requires Class II ODS in their operations or maintenance (i.e. HCFC-123 chillers).

6.3 Asbestos

6.3.1 Background: Asbestos Containing Materials (ACMs) are heavily regulated in all phases of their use and disposal. Some of these regulations include U.S. EPA's guidance document 560/5-85-024, AFOSH Standard 48-8, National Emission Standard for Hazardous Air Pollutants 40 CFR 61 Subpart M, Ohio EPA OAC 3745-20 AFI 32-1052, Asbestos Hazard Emergency Response Act (AHERA) 40 CFR Part 763, OSHA Regulations 29 CFR 1926.1101 and 29 CFR 1910.1001 and Ohio Department of Health OAC 3701-34.

6.3.2 Action: The A/E is responsible for ensuring a THOROUGH project design survey is conducted to determine if ACMs are present, and when identified, the ACMs shall be labeled as such. The person conducting the project design survey shall be certified as an Asbestos Hazard Evaluation Specialist by the State of Ohio IAW OAC 2701-34-02 (C). The survey shall include but is not limited to identifying the location of samples taken on a detailed drawing, the description and condition of the material sampled and the results of the sample analysis. The survey shall be performed in accordance with all requirements of Section 8, "Pre-construction Surveys" of ASTM E2356-10 "Standard Practice for Comprehensive Asbestos Surveys." AHERA requires the use of laboratories accredited under the National Voluntary Laboratory Program (NVLAP). Survey and analysis results shall be included in the preliminary (35%) design analysis. The survey shall be provided to the designer performing the design. A State of Ohio certified Project Designer shall design the asbestos removal/abatement portions of the project. The final drawings and specifications shall clearly indicate the location of the ACMs, extent of removal or other abatement and indicate all relevant regulatory procedures, etc.

6.3.3 Action: There may be limited historical asbestos data available for some Base facilities. Contact 88 CEG/CEIEC at 257-9049 or 257-5536 to obtain any available data. Any data obtained from previous asbestos surveys does not negate the regulatory requirement to perform a thorough NESHAP survey for a building that will be demolished or renovated.

6.4 Environmental Impact Analysis

- 6.4.1 Background: The National Environmental Policy Act (NEPA) of 1969 requires federal agencies to consider the environmental and historic impacts of proposed actions in the decision making process. The intent of NEPA is to protect, restore, and enhance environmental and cultural/historic resources through well-informed federal decisions. The Air Force implements NEPA requirements through 32 CFR Part 989, Environmental Impact Analysis Process (EIAP). The EIAP at WPAFB is managed by the Installation Management Division, Environmental Branch, 88 CEG/CEIE.
- 6.4.2 Action: For any proposed work, the status of the EIAP shall be obtained from 88 CEG/CEIEA (257-5899 or 656-3454) prior to the expenditure of government funds and performance of the action.
- 6.4.3 Action: If an Environmental Assessment (EA) has been/is being prepared for the proposed action, a copy of this document shall be provided to the designer by the project proponent. Design requirements are frequently made in the EA as a means to mitigate potential adverse impacts from execution of the proposed action. These mitigative measures shall be incorporated in the facility design IAW the EA, if one exists. The expenditure of government funds and construction activity cannot begin until the EA has been approved and a Finding of No Significant Impact (FONSI) is signed by 88 CEG or a FONSI/Funding of No Practicable Alternative (FONPA) is signed by HQ AFMC and/or AFCEC.

6.5 Hazardous Materials

- 6.5.1 Background: WPAFB shall maintain accountability and control of all hazardous materials (HAZMAT) on the installation. 88 CEG/CEIE HAZMAT Cell is responsible for managing all HAZMAT in accordance with the Base Installation HAZMAT Management Program (IHMP) Plan and AFI 32-7086 Hazardous Material Management.
- 6.5.2 Action: Project design shall take into account that HAZMAT shall be stored and used appropriately and shall allow dedicated space for storage of HAZMAT, if needed. The use of Class I Ozone Depleting Substances (ODSs) is prohibited on the installation unless written permission is obtained by the HAZMAT Cell (257-8028 or 257-7152). All Class I ODSs taken out of service shall be captured in the environmental survey and returned to the DLA ODS Bank in Virginia IAW WPAFB specification 02 09 10. Examples of units that contain Class I ODSs are water fountains and refrigerator units.
- 6.5.3 Action: The National Fire Protection Association (NFPA) Standard 45 Sections 8.11.1 through 8.11.11 require that laboratory activities using perchloric acid be performed in appropriately designed perchloric acid fume hood systems. Project design shall take into account any projected usage of perchloric acid or other perchlorate materials in the design of the fume hood systems IAW NFPA 45 Section 8.1.1 through 8.1.11. All such fume hoods shall be designated for perchloric acid use only, and shall be of the type that is

specifically required for perchloric acid usage with a working and leak-proof wash down system.

6.6 Hazardous Waste

6.6.1 Background: Hazardous waste management is subject to regulation by both federal and state EPA, as well as DOD and AF Regulations.

6.6.2 Action: Project design shall take into account the types of hazardous materials to be used, and the wastes that may be generated as a result of that use. Project design shall allow dedicated space for storage of hazardous waste, and that space shall be constructed to meet specific standards (sealed floor, concrete containment berm, firewalls, etc.). Questions concerning the requirements for storage and disposal of any hazardous waste generated at WPAFB can be addressed by 88 CEG/CEIEC (257-3349 or 257-7152).

6.7 Historic Preservation Requirements

6.7.1 Background: The Air Force policy for cultural resources is to integrate historic preservation requirements with planning and management of other activities, and to consider cultural resources during the earliest stages of project planning so as to reduce conflicts with the military mission and other management objectives (AFI 32-7065). The National Historic Preservation Act of 1966 and AFI 32-7065 require affirmative responsibilities of federal agencies to preserve historic and prehistoric resources. Any property (site or structure, or both) that may qualify for listing on the National Register of Historic Places shall not, by NHPA and AFI 32-7065, be inadvertently demolished or altered or allowed to deteriorate. The Archaeological Resource Protection Act of 1979 (ARPA) also protects all archaeological resources from illicit use, including excavation and removal from federal lands. The Air Force (WPAFB) is required to identify, protect, and use the historic resources under its control.

6.7.2 Background: The Air Force encourages practical rehabilitation and adaptive reuse of historic properties when operational needs can be supported. Whenever feasible, historic properties shall be used before acquiring, constructing, or leasing new buildings. Guidelines for rehabilitating and maintaining historic properties are found in the Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings. WPAFB's historic properties are identified by the Base Cultural Resources Manager (CRM), 88 CEG/CEIE, in consultation with Ohio's State Historic Preservation Office (SHPO). A current list of WPAFB historic facilities can be obtained by calling the CRM (257-1374 or 656-3454).

Action: These properties and sites may not be modified or demolished without completion of a Section 106 process. The expenditure of government funds and any work (undertaking) cannot begin until the Section 106 process is completed. This review requires that an "assessment of effect" be made by the CRM.

- 6.7.3 This assessment enables the installation, in consultation with the SHPO, and, where necessary, the Advisory Council on Historic Preservation (ACHP) to identify the effects that a proposed undertaking may have on historic resources. Consultation during the Section 106 review process provides an opportunity for SHPO, and when necessary the ACHP, to comment on an undertaking. In some cases this may result in an agreement that undertakings which cause adverse effects to the property will be avoided or minimized.
- 6.7.4 Action: Any proposed work (undertaking) inside, on, or in the vicinity of a historic property shall be presented to the CRM at the earliest stage possible in the planning process. The expenditure of government funds and any work cannot begin until the Section 106 process is completed. If necessary, it shall be the responsibility of the designer adhering to the BFS to contact the CRM at the onset of the proposed work, in order for the CRM to coordinate the plans with the SHPO. Any project requiring coordination with the SHPO will need to incorporate a 45 day review cycle into the planning process, typically at the 35% design stage. All coordination with the SHPO is accomplished by the CRM.

6.8 Defense Environmental Restoration Program

- 6.8.1 Background: The USAF has two restoration programs under the Defense Environmental Restoration Program (DERP) at active/operating AF installations, the Installation Restoration Program (IRP) and the Military Munitions Response Program (MMRP). The IRP is regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 and is intended to identify, investigate, and remediate past hazardous waste sites. WPAFB currently has identified seventy-two (72) IRP sites. The program at WPAFB is also regulated by Ohio Administrative Orders on Consent from Ohio EPA (1988) and a Federal Facilities Agreement with U.S. EPA Region V (1991). The MMRP addresses the potential explosives safety hazards presented by munitions and explosives of concern (MEC), which include unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) concentrations high enough to pose an explosive hazard and potential environmental contamination. Munitions response actions will be conducted under the process outlined in the National Contingency Plan (NCP) 40 Code of Federal Regulations (CFR) 300 as authorized by CERCLA, 42 United States Code (U.S.C.) 9605, as amended by the Superfund Amendments and Reauthorization Action (SARA) 1986, Pub. L. 99-499. There are five Munitions Response Areas (MRAs) at WPAFB being evaluated under the Comprehensive Site Evaluation (CSE) Phase II MMRP.
- 6.8.2 Action: Project design shall take into account any construction or excavation atop or within 300 feet of any IRP or MMRP site. The Land Use Control (LUC) Implementation Plan and the WPAFB's Geographical Information System (WPAFB GeoBase Viewer), which is part of the Installation Development Plan (IDP), shall be referenced. Any work proposed within the established boundaries of an IRP or MMRP site shall be coordinated with Air Force Civil Engineer Center (AFCEC/CZO at Wright-Patterson AFB) (257-6391, 257-8591, or 257-2201). This includes necessary soil excavation planned for an IRP site or within 300 feet of IRP sites that are considered waste placements. In accordance with OAC 3745-27-

13, application to Ohio EPA must be made for excavation activities within 300 feet of waste placements 45 days prior to disturbance.

6.9 Landscaping

6.9.1 Action: Plant species should be selected based on hardiness (Zone 5) and adaptability to SW Ohio soil types (generally alkaline pH). Raised planters should be of sufficient length and width to accommodate group plantings. Planters with artificial bottoms are discouraged. Fabric weed mats should be used with anything other than single plantings that are mulched. When planning and/or planting trees or shrubs the "10-20-30 diversity rule" should be utilized such that the plants should be no more than 10% from the same species, no more than 20% from the same genus, and no more than 30% from the same family. All landscaping (including use of raised planters) should be approved by the Base Natural Resources Program Manager (NRPM), 88 CEG/CEIE (257-4857 or 257-5535). A list of plants that should NOT be planted on WPAFB is available in section 3.11.1 and from the Base NRPM.

6.9.2 Action: Landscaping within the Base's historic districts should also be coordinated with the Base Cultural Resources Manager, 88 CEG/CEIEA (257-1374 or 656-3454).

6.10 Lead-Based Paint and Protective Coatings

6.10.1 Background: Prior to 1978, paints and other coatings were often formulated with significant amounts of lead additives. In 1978, the Consumer Product Safety Council banned the sale of lead-based paint for residential use; however, lead-based paints can still be purchased for industrial use. Governing regulations include: 29 CFR 1926.62, 29 CFR 1910.1025, 40 CFR 240-280, and Housing and Urban Development (HUD) rules. For the purpose of complying with OSHA requirements, all painted surfaces on WPAFB are assumed to be lead containing; therefore, lead analysis is not required. However, if there is reason to believe painted surfaces that will be disturbed do not contain lead, tests may be performed by the designer. In this case, the XRF screening process on WPAFB is not allowed, only bulk sampling results will be accepted. The samples shall be analyzed by a laboratory accredited by the National Lead Laboratory Accreditation Program.

6.11 Universal Waste

6.11.1 Background: According to OAC rule 3745 Chapter 273 as long as mercury-containing lamps (light bulbs), batteries, pesticides, and mercury-containing equipment are recycled, they are not subject to the full hazardous waste rules. Mercury-containing lamps include fluorescent, mercury vapor, metal halide, and high pressure sodium lamps. Universal waste batteries include lithium, nickel-cadmium, lead-acid, mercury and silver-zinc types; they do not include dry cell alkaline batteries.

- 6.11.2 Action: Universal waste items shall be identified in the environmental survey. Electronic light ballasts with nickel-cadmium, lithium-ion, or other universal waste batteries contained in the units require disassembly to remove the universal waste batteries, and the batteries then must be turned in to 88 CEG/CEIE for further management. Questions concerning universal waste can be addressed by 88 CEG/CEIEC (257-7152).

6.12 Natural Resources

- 6.12.1 Background: Air Force Instruction 32-7064, Integrated Natural Resources Management, guides installations in managing their natural resources programs. DOD Directive 4700.4, Natural Resources Management Program, issued in 1989, established requirements for the coordination and integration of natural resources programs with other Base activities. As a result of this directive, the following Air Force policy was established: "All current and planned installation activities (e.g., master planning, construction requests, site approval requests, and training exercise plans) shall be planned and conducted so as to ensure effective and timely coordination with installation natural resources management personnel." In addition, the Air Force Environmental Quality Program, as outlined in Air Force Policy Directive (AFPD) 32-70 requires that WPAFB protect and enhance wetland resources on the Installation. To comply with AFPD 32-70, all activities on WPAFB shall conform to Sections 404 and 401 of the Clean Water Act and OAC 3745-1: -50, -51, -52, -53, and -54 and OAC 3745: -32, -33, and -38. Impacts to wetlands that are determined to be hydrologically isolated from other waters of the United States, and therefore not regulated under the Clean Water Act, are regulated under Section 6111.021 of the Ohio Revised Code.
- 6.12.2 Action: The project design shall comply with the 100-Year Floodplain/Huffman Retarding Basin Requirements (Reference Miami Conservancy District (MCD) Land Use Policy for more details). Approximately 80 percent of WPAFB lies within the Mad River floodplain. Most of Area A is behind Huffman Dam within the Huffman Retarding Basin and subject to flooding. The flood control basin behind Huffman Dam is regulated by the MCD to limit land use and construction on the property. The MCD has the right to back water upon and over the property behind Huffman Dam. Also, structures or additions of any type shall not be erected more than 5 feet below the spillway elevation of Huffman Dam, 834.1 (NAVD88), except by MCD authorization. The MCD has established policies for activities within the floodplain, with which WPAFB complies:
1. **Building Restrictions.** No temporary or permanent structures and/or improvements are to be constructed within the Huffman Retarding Basin without prior written MCD approval. All conforming (new) habitable structures shall be located or constructed on natural ground (land that has not been altered by construction such as filling or grading) at or above the minimum building elevation, 813.4 (NAD83/NAVD88). Foundations and basements for these structures may extend below the minimum building elevation provided there are no openings below the minimum building elevation. Additions to conforming habitable structures, regardless of size, can only be constructed if the lowest natural ground elevation, where the addition is to be constructed, is at or above

the minimum building elevation. Remodeling and/or repair to a conforming habitable structure will be permitted. Non-conforming (pre-existing) habitable structures: additions to non-conforming habitable structures regardless of size and/or location are prohibited. Remodeling which does not change the basic use or increase the square footage of the structure will be permitted. New non-habitable structures: The following structures and/or facilities can be constructed or located below the minimum building elevation subject to prior Miami Conservancy District approval: Garages (non-attached) associated with an existing habitable structure; out buildings; storage sheds; utility structures; gravel operation facilities and recreational facilities such as shelters (open on at least 3 sides). The total square footage of all permanently constructed non-habitable structures shall not exceed 5% of that portion of the property located below the minimum building elevation (All legal structures existing prior to Jan 1, 2002 will be exempt from this limitation except for the purpose of calculating limitations for future construction.). Pre-existing non-habitable structures may be used for any use considered compatible within a retarding basin subject to written District approval.

2. **Placement of Fill Material:** Prior to the placement of fill material in excess of four cubic yards on property located within any retarding basin, the designer shall acquire a Storage Compensation Agreement. The agreement holder is required to remove an equal amount of material from the retarding basin to compensate for the lost flood storage. All agreement applications shall include detailed plans for the proposed project. MCD may require additional information such as an elevation survey of the property and storage calculations. The agreement holder shall agree to the terms and conditions in the agreement and pay the agreement fee, if applicable. The placement of fill material within a retarding basin for the purpose of raising the natural ground elevation above the minimum building elevation is prohibited. All projects requiring placement of fill material on Base property within the 100-year floodplain and/or Huffman Retarding Basin shall be approved by the NRPM. All projects that require removing fill material from the retarding basin without replacing that material are potentially eligible for "fill credits". It is the designer's responsibility to coordinate potential credits with the NRPM and request and obtain "fill credits" from the MCD. All credits received by the MCD through the designer shall be reported back to the NRPM for the purpose of maintaining a "credit bank" that will be coordinated with the MCD. Additional information can be obtained from the NRPM (257-4857 or 257-5535).

6.12.3 Action: Any project in or near the following shall be coordinated with the Base NRPM (257-4857 or 257-5535), in accordance with DOD Directive 4700.4:

1. Forests
2. Agriculture and out leases
3. Threatened or endangered species habitats
4. Outdoor recreation areas
5. Prime farmland
6. Wetlands (EO 11990)
7. Fish and wildlife habitat
8. 100-Year Floodplain/Retarding Basin

Locations of these areas are available from the Base NRPM and most locations are available from Base Civil Engineering's Record Drawings Section. Some of these areas are located in the Base General Plan. Depending on the project circumstances, if there are impacts to wetlands and/or streams, Sections 404 (Corps of Engineers) and 401 (Water Quality Certification – Ohio EPA) of the Clean Water Act may be required. All necessary permits shall be obtained prior to impacting any wetland and/or stream. The designer is responsible for preparing and submitting these permits to the NRPM for approval and submission to the regulatory agencies. Additional information can be obtained from the NRPM (257-4857 or 257-5535).

6.13 Polychlorinated Biphenyl (PCB)

6.13.1 Background: Polychlorinated Biphenyls (PCB) are regulated under the Toxic Substances Control Act (TSCA). PCB may be found in electrical devices as a dielectric fluid or in miscellaneous devices requiring heat resistant characteristics (i.e., industrial processing equipment, hydraulic systems, air compressors, capacitors, light ballasts, etc.). Specific regulations are listed in 40 CFR Part 761. It is important to note that PCB is regulated according to its concentration, and that PCB regulations segregate devices containing PCB into three classes: PCB, PCB-Contaminated, and Non-PCB. The "PCB" classification pertains to devices containing 500 parts per million (ppm) PCB and requires the most stringent regulations. Devices found to contain PCB between 50 and 499 ppm are classified as "PCB-Contaminated." "non-PCB" refers to devices that are above the detection limit but below 50 ppm. These are regulated from a waste disposal perspective only. 88 CEG/CEIEC has performed a Base-wide PCB survey in an attempt to identify all potential PCB-containing devices. All surveyed equipment has been labeled and recorded in a central database system, which is maintained by 88 CEG/CEIEC, (257-2889 or 257-7152). As such, equipment tracking is of prime interest and all movement of PCB and suspected PCB items shall be coordinated through 88 CEG/CEIEC.

6.13.2 Action: A survey shall be performed to identify all devices that may contain PCB. Each device identified shall then be characterized as PCB, PCB-Contaminated, or Non-PCB. Sampling will be required only where the PCB concentration cannot be determined from labels and/or 88 CEG/CEIE records. Excluded from sampling are those items hermetically sealed (these shall be assumed to be PCB). Once the concentration is known, applicable provisions of the regulation shall be applied.

6.14 Radiation Safety Program

6.14.1 Radioactive Material

6.14.1.1 Background: The Base Radiation Safety Program is regulated under the Atomic Energy Act (AEA) of 1954, as amended. Pursuant to AEA, the U.S. Nuclear Regulatory Commission promulgated regulations regarding the receipt, possession, and use of radioactive material. Authority for Air Force receipt, storage, internal

distribution, use, transfer, and disposal of byproduct, source, and limited quantities of special nuclear material is granted through a Master Material License issued to the USAF Radioisotope Committee (RIC). The RIC has published regulations (AFI 40-201 and 48-148) to enforce those requirements.

- 6.14.1.2 Action: Project design shall consider components that contain radioactive material which may be installed. The use of tritium emergency exit signs is a prohibited acquisition IAW AFI 40-201, however, if situations arise that require the installation of tritium emergency exit signs, those plans shall be communicated with the WPAFB Radiation Safety Officer (RSO) in order to gain written approval from the USAF RIC prior to procurement. Assistance may be obtained from Radiation Safety, 88 CEG/CEIEC (257-2010).

6.14.2 Public Exposure

- 6.14.2.1 Background: Public exposure not only includes medical and occupational exposures, it also includes exposure to naturally occurring radioactive materials, with the largest contributor being the internal dose from radon progeny. Public exposure to ionizing radiation is to be minimized IAW published AF requirements (AFI 40-201 and AFI 48-148). WPAFB is considered to be a Medium Risk installation. Newly constructed or acquired structures on “Medium Risk” and “High Risk” installations shall be assessed by the installation RSO for exposure to radon progeny, with the exception of: hangars, maintenance bays, dedicated storage facilities, structures occupied less than four hours per day, temporary facilities, and elevated structures with unobstructed air flows underneath.
- 6.14.2.2 Action: IAW AFI 48-148 Ionizing Radiation Protection section 5.3 and specifically: 5.3.1.3, Base Civil Engineering should design and construct new structures on “Medium Risk” and “High Risk” installations with radon resistant features. Renovation of existing structures will be handled on case-by-case basis.

6.15 Underground Storage Tanks (UST)/Aboveground Storage Tanks (AST)

- 6.15.1 Background: OAC 1301: 7-9-10 and 7-9-12 and AFI 32-7044 identify permitting procedures required for UST's including installations, modifications, changes in service, or temporary or permanent closure (either removal or abandonment in place). For installation of new underground tanks, the Ohio Bureau of Underground Storage Tank Regulations (BUSTR) requires a permit. Federal Regulation, 40 CFR Part 280, and OAC 1301: 7-7-28 and 7-9-06 through 7-9-12 shall be referenced for all requirements regarding UST installation and operating procedures, design standards, and closure procedures, as well as third party inspections of installations, upgrades and abandonments. Underground storage tank systems shall be of double-wall construction, compatible with the material to be stored, and equipped with an automatic tank gauging and release detection system capable of detecting a release from any portion of the tank and piping that routinely contains a regulated substance. All UST systems shall meet Ohio Fire Marshal Bureau of

Underground Storage Tank Regulation (BUSTR) Sensitive Area requirements per the OAC 1301 regulations. In addition, all UST systems shall have spill containment basins surrounding the fill port and overfill prevention equipment. AF policy recommends the use of suction piping with an aboveground pump and minimized piping runs. AST installations shall meet 40 CFR 112.8 and WPAFB Spill Prevention Control and Countermeasure (SPCC) Plan requirements. All AST systems shall be of double-wall construction, compatible with the material to be stored, and equipped with an overfill alarm and release detection system. All AST systems shall have spill containment basins surrounding the fill port and overfill prevention equipment. If it is not feasible to provide double-wall construction for AST systems, then external secondary containment shall be provided of sufficient capacity to hold the entire capacity of the largest single container, including piping, and sufficient freeboard to contain precipitation from a 25year, 24-hour storm event. External containment systems shall be properly and periodically maintained to ensure integrity and imperviousness. The SPCC Plan and the plan requirements may be accessed through the Storage Tank PM, 88 CEG/CEIEA (257-5899).

- 6.15.2 Action: All project designs involving any actions with UST's or AST's shall be coordinated through the Storage Tank PM (257-5899) to ensure all UST/AST regulatory concerns are addressed. Project designs involving metal tank system components shall be coordinated with the Base Corrosion Control Specialist in 88 CEG/CEOER (904-2201) for corrosion and cathodic protection requirements. In addition, notification of planned tank installations shall be made to the local fire authority, WPAFB Fire Dept., 788 CES/CEXF (257-4075). Installation of new USTs is discouraged and shall be justified. Due to new regulations in OAC 1301: 7-9-12, -13, -14, -16, and -17, all contracts for UST removals shall require contaminated soil to be disposed at a treatment facility.

6.16 Water, Wastewater and Stormwater

- 6.16.1 Background: The Ohio EPA requires that water, wastewater, and stormwater-related projects be designed to meet certain specifications. Section 438 of the Energy Independence and Security Act (EISA) applies if the project increases or installs impervious surfaces exceeding 5,000 square feet. Depending on project details, Ohio EPA may require a Plans Approval, a Permit to Install (PTI), or a National Pollutant Discharge Elimination System (NPDES) permit for water, wastewater, and stormwater structures, respectively. NPDES Construction General Permit coverage, including a Storm Water Pollution Prevention Plan (SWPPP), is required for all construction sites where one (1) acre or more of land will be disturbed. Less than one (1) acre of land disturbance requires an Erosion Control Plan. Sections 404 (Corps of Engineers) and 401 (Water Quality Certification – Ohio EPA) of the Clean Water Act may be required if the project causes impacts to wetlands and/or streams.
- 6.16.2 Action: Permittee responsibilities will remain with the construction contractor for the duration of the construction project. A complete SWPPP shall be submitted to the Water Quality PM, 88 CEG/CEIEA, at least 7 days prior to submittal of the Notice of Intent (NOI) to Ohio EPA. Once the SWPPP is approved, the permittee shall submit the NOI and

application fee to Ohio EPA at least 21 days prior to the start of any construction activities. For Drinking Water, a Plans Approval applications shall be sent to the Water Quality PM for construction of a water main for a new building or addition to a building, replacing a main that is larger than an existing main, or extending an existing main. For wastewater, PTI applications shall be sent to the Water Quality PM for construction of wastewater collection, conveyance, storage, treatment or disposal facilities. Additional design requirements may be imposed by other federal (including Air Force), state, county, and municipal regulatory authorities.

- 6.16.3 Action: Project shall be designed in compliance with all applicable federal (including Air Force), state, county, and municipal environmental laws and regulations, as well as any applicable existing permits and administrative orders. Design standards and permit requirements shall be identified in the concept design phase. The designer shall submit Operation & Maintenance Manuals for any post-construction best management practices that are to be included as part of the project design IAW the Ohio EPA Construction General Permit. Designs that construct or expand facilities with a footprint greater than 5,000 square feet must incorporate innovative storm water technologies, such as Low Impact Development (LID), to the maximum extent practicable in accordance with Energy Independence and Security Act (EISA) Section 438 requirements. The A/E must complete the Air Force EISA worksheet detailing project applicability and measures taken to meet the requirements. Once complete, the worksheet must be submitted to the Government for review. Where designs include the installation of backflow prevention devices, the units shall be Ohio EPA approved and they shall be installed no higher than 1.5 meters (5 feet) above the floor. Designs to install oil/water separators (OWS) shall be coordinated and approved with the CE Water Systems Engineer, the Water Quality PM, the facility user, and the project Design Engineer in a pre-design conference. AFI 32-7041, Water Quality Compliance (January 2010) shall be made part of all design projects whether the project is designed in house or by contract. Additionally, a PTI issued by Ohio EPA may be required for OWS installation.
- 6.16.4 Action: During the design process, the A/E designer shall identify all permit requirements and complete all necessary permit application documentation for final submission to the Government. The construction contractor finalizes all permit applications (including fees) and submits the applications with any necessary supporting documents, including pertinent construction drawings and specification sections, to the Water Quality PM for review and processing on to the regulatory authority. The application form and instructions can be found on the Ohio EPA web page, <http://web.epa.ohio.gov/dsw/pti/PTIForms.html> or may be obtained by calling the Water Quality PM (257-5899 or 257-2201). Three sets of stamped drawings, one copy of specifications, one copy of the Water Supply Data Sheet, and one copy of supporting information are required by Ohio EPA for plans approval packages; four sets of stamped drawings, two copies of Form A, two copies of the corresponding Form B, and two copies of the Antidegradation Addendum Form if applicable are required by Ohio EPA for PTI applications; and two sets of the NOI Application and SWPPP for NPDES applications. Additional copies may be required by the Government in addition to those submitted to the regulatory authority. The designer shall not contact Ohio EPA or any other regulatory agency on behalf of WPAFB, unless

permission is given by the appropriate PM from 88 CEG/CEIEA. All inquiries shall be routed through the Water Quality PM (257-5899 or 257-2201).

6.17 Green Procurement

6.17.1 Background: Green Procurement is the purchase of environmentally preferable products and services in accordance with the Federally-mandated green procurement program (GPP) elements. There are six mandatory program elements and one voluntary element that are governed by several laws, Executive Orders (EOs), and regulations. The six mandatory programs elements are:

- **Recovered Materials** (Formerly Affirmative Procurement) driven by Resource Conservation and Recovery Act (RCRA) section 6002, EO 13423, EO 13514 and 40 CFR Part 247 requires Federal agencies to purchase recovered material products that satisfy EPA's Comprehensive Procurement Guideline (CPG). The CPG is a list of products that can be made with recovered materials, are technologically and economically feasible to produce, and will conserve raw materials and reduce the solid waste stream. CPG products with the highest percentage of recovered materials practicable shall be utilized, unless otherwise specified, or if one or more of the following exemptions apply:
 - Does not meet appropriate performance specifications.
 - Is not available competitively (from two or more sources).
 - Is not available within a reasonable time frame.
 - Is only available at an unreasonable price
- **Energy and Water Efficient Products** driven by the Energy Policy Act (EPACT) of 1992, EO 13221, EO 13423, and 13514 requires Federal agencies to reduce energy use, purchase energy-efficient products, increase the use of renewable energy, and conserve water.
- **Alternative Fuels and Fuel Efficiency** driven by the EPACT of 2005, EO 13150, EO 13423, and EO 13514 requires Federal agencies to purchase alternative fueled vehicles (AFV), alternative fuels, and fuel efficient vehicles.
- **Biobased Products** driven by the Farm Security and Rural Investment Act of 2002 (FSRIA) section 9002, 7 CFR Part 2902, EO 13423, and EO 13514 requires Federal agencies to select biobased items from the USDA published product list.
- **Non-Ozone Depleting Substances** driven by the Montreal Protocol of 1987, EO 13423, EO 13514, and AFI 32-7086 requires Federal agencies to meet all mission critical Class I ODS requirements from the DLA ODS Reserve, find alternatives to the continued use of Class I and Class II ODS, and purchase approved alternatives to ODS products from the EPA's Significant New Alternatives Policy (SNAP) Program.
- **Priority Chemicals** driven by EO 13423 and 13514 requires Federal agencies to reduce usage of priority chemicals. The EPA has defined the priority chemical list to include cadmium, lead, polychlorinated biphenyls (PCBs), mercury, and naphthalene.

The voluntary program element is:

- **Environmentally Preferable Products (EPP)** mentioned in EO 13423 and EO 13514 encourages Federal purchasers to follow EPA's Environmentally Preferable Purchasing (EPP) guidelines as part of the GPP.

6.17.2 Action: Project Design shall implement the GPP. Additional information can be obtained from 88 CEG/CEIEC (257-7152), EPA's CPG Products page (<http://www.epa.gov/cpg/products.htm>) or AFCEC's Green Procurement web page. The information can be found by going to the Green Procurement Guide link in the "Guidance Documents" section of the web page.

6.18 Recycling

6.18.1 Background: In accordance with AFI 32-7042, WPAFB highly promotes and endorses the installation recycling programs and disposal services as described in the WPAFB Qualified Recycling Plan.

6.18.2 Action: Project design shall incorporate recycling bins for paper as part of the furniture package. This includes recycling bins for workstations, printer/copier locations, conference rooms, and building collection locations. Parking lots shall be designed to include areas for recycling dumpsters. Additional information concerning this plan can be obtained by calling the Recycling PM (257-5060 or 257-7152).

6.18.3 Action: Project design shall consider deconstruction activities as opposed to demolition where feasible so that materials can be reused or recycled.

6.18.4 Action: Project design shall include provisions that require the contractor to recycle all recyclable materials through the WPAFB Recycling Center. Recyclable materials include piping, fittings, conduit, electrical wire, cast iron, other metals, paper, and cardboard.

6.19 Environmental Management System

6.19.1 Background: Executive Order 13514 – *Federal Leadership in Environmental, Energy, and Economic Performance* requires that all federal facilities to implement an Environmental Management System (EMS). The required elements of the mandated EMS are found in the ISO 14001:2004(E) *Environmental management systems – Requirements with guidance for use*. Section 4.4.2 Competence, training, and awareness requires all individuals working for or on the behalf of the organization receive awareness level training specific to the installation EMS. This includes government employees and contractors working on the installation.

6.19.2 Action: Project design shall take into account the guidelines of the mandated EMS IAW the environmental sections of this document.

6.20 Infectious Waste

6.20.1 Background: Infectious Waste is subject to regulation (OAC 3745-27 and 3745-37) by the State of Ohio EPA, as well as AF Regulations.

6.20.2 Action: Project design shall take into account the amounts of Infectious Waste or Animal and Plant Health Inspection Services (APHIS) waste generated in the designed space and shall allow for dedicated space for storage. APHIS waste includes any foreign soil or sand samples brought into the United States. All Infectious Waste storage areas shall be capable of being secured and properly labeled. Prior to the generation of either APHIS or Infectious Waste, 88 CEG/CEIEC (257-7152) shall be contacted concerning the requirements for storage and disposal of any APHIS or infectious waste generated at WPAFB.

7.0 MECHANICAL

7.1 Introduction

Designs shall be in conformance with the applicable portions of the latest editions of UFC's, ETL's, AFI's, IBC, NFPA, ASHRAE and ASME Standards, the Energy Policy Act (EPACT), and CFR Title 10 PART 435-*ENERGY CONSERVATION VOLUNTARY PERFORMANCE STANDARDS FOR NEW BUILDINGS*; MANDATORY FOR FEDERAL BUILDINGS

All new facility planning will consider the use of closed loop Ground Source Heat Pumps (GSHP) or the use of Thermal Energy Storage technologies.

All new construction where a "campus" or "complex" design for multiple facilities is planned, the design shall include consideration for simple or advanced district cooling system. Analysis for advanced district cooling systems will incorporate Thermal Energy Storage technology.

All equipment replacements must be within the top 25% energy efficiency or Energy Star compliant.

7.1.1 Design for HVAC Mechanical Systems

Designer shall use UFC 3-400-2, Design: Engineering Weather Data values listed for either 0.4% or 1.0% Occurrence as their criteria per UFC 3-410-01 Heating, Ventilation, and Air Conditioning. WPAFB is Station #745700 on the AFCCC website.

- The designer shall utilize indoor space design values of 74 Deg F for summer cooling and 70 Deg F for winter heating for comfort cooling/heating spaces.
- Fiberboard is prohibited on all air distribution, return, exhaust, or other ventilation systems.
- Internally lined ductwork shall not be used on any distribution, return, exhaust, or other ventilation system, unless required per ICD 705.

7.1.2 Field Investigation

Existing conditions survey shall include all Industrial Control Systems (ICS) and connections to the CE Energy Management Center.

7.2 Air Conditioning Systems, Chillers, and Air Handling Systems

Locate equipment to allow reasonable access for maintenance.

- Air handling units shall not be located above ceilings or on rooftops unless approved during design by the Government.
- Isolation valves shall be provided on all mechanical equipment as applicable.

- Install bypasses on all strainers that serve critical, heat generating, or cooling generating equipment to allow maintenance without system shutdown.
- All equipment requiring scheduled maintenance more frequently than annually (i.e. VAVs, Exhaust Fans, Terminal units, Dampers, etc) shall be accessible by maintenance personnel from the finished floor or a permanent platform designed for maintenance. When equipment is located higher than 12 feet above finished floor and the designer determines not to provide a permanent platform designed for maintenance, then the designer shall coordinated with all disciplines to ensure floor space for ladder or lift setup is provided. When ladder is only means for accessing equipment, design shall incorporate permanent hooks and eyelets for portable winch use to facilitate replacement of coils and motors.

7.2.1 Air Handlers

- Trane M-Series Climate Changer or better. Solid double-wall panels; Fiberglass insulation in 1-1/2 lb / ft³ and 3 lb/ft³ densities with thermal resistance of 8.33. The air-handler enclosure, structural members, access doors, filter racks and fan/motor mounts shall be constructed of hot dipped G90 galvanized steel. All conduit inside the air handler, except for flexible conduit at the motor connection, shall be galvanized rigid steel conduit. Corrosion protect cut edges, burns, and scratches in galvanized surfaces to ASTM A780 standards. The drain pan shall be Type 304 stainless steel with silver-soldered joints. Access doors shall be surface mounted with heavy duty non-casing piercing door handles, hinged with removable hinge pins for easy door removal, and equipped with glass view windows for damper, coil, and motor sections. Fan wheels shall be keyed to fan shaft to prevent slippage and fan shafts shall be solid. Condensate pans shall be constructed from 22-gage Type 304 stainless steel with silver-soldered joints.
- Design shall consider air-to-air fixed plate heat exchangers for energy recovery on units smaller than 10,000 CFM and for 100% outdoor air applications for simple dehumidification.
- Design shall consider rotary enthalpy wheel, the coil energy recovery loop (run-around loop) and the heat pipe. Analysis performed shall determine the annual estimated energy savings. System first cost, simple payback period, annual operating cost, and maintenance must be considered.
- Air Blenders: Specify air blenders wherever the risk of air stratification can occur. The mixed air section in air handlers needs to be properly designed for air blending. Return air and outside air should enter mixing box very close to each other and in a position that forces the two streams in to each other, preferably with the cold outside air on the top. Design shall achieve a 3-5°F spread between the warmest and coldest spot in the plenum discharge of the mixed air section.
- All condensate pans shall be constructed of 22 Ga. or thicker Type 304 stainless steel. Threaded stainless steel drain port(s) shall be made water tight or soldered.

- Air handling units shall not be equipped with filters in excess of MERV 8 unless mission or occupancy dictates a higher level of filtration.

7.2.2 Variable Air Volume (VAV) Systems

- Air conditioning equipment for VAV systems will be chilled water. Direct Expansion (DX) system will not be used on VAV systems without written exception from 88 CES/CEOER Requirements and Optimization Section.
- Electric reheat will not be used in VAV boxes when hot water is available and used within the facility. Electric reheat can be used only when system dehumidification is required.
- Reheat will not be designed for use during the summer cooling season on systems designed for comfort only. Design will include condition; whenever reheat media is not available, all reheat VAV boxes equipped with shall act as cooling only boxes.
- This decision process relies on a deadband between heating and cooling. Federal regulations (10 CFR 435) requires a deadband between heating and cooling in most situations for all federally owned buildings.
- Non Fan powered VAV boxes will be used. If Fan powered VAV boxes are required due to design constraints, then Parallel FP-VAV with Electrically Commutated Motor (ECM) will be used.
- The ductwork at the inlet to a VAV Box shall be straight, and the same size as the inlet to the box, with a length of 2.5 duct diameters. Flex duct is prohibited.
- A Maximum of 6 feet of ductwork between a VAV Box and a diffuser may be flexible.

7.2.3 Chilled Water Systems

- When a design calls for year round cooling, the design analysis must include the determination used for selecting an Air Cooled chiller over a Water Cooled chiller. The water cooled chiller design shall include utilization of water economizer technology for providing cooling during the heating season.
- Chilled water systems shall be designed to preclude the need to drain the system during non-cooling seasons where chilled water coils are exposed to freezing and sub-freezing temperature.
- A water/glycol designed system shall use Propylene glycol (phosphate based) in lieu of Ethylene Glycol. Glycol to have ZERO silicate content.
 - A basic glycol make-up package consisting of a solution reservoir and pump pressurization control station shall be included into the design.
 - Pump runtime will be trended for change of state indication and monitored through EMCS.
 - Water/Glycol mix shall provide freeze protection to 0 Deg F.
- All heat transfer devices will include temperature and pressure indicators on both the inlet and outlet, with the exception of VAV boxes.

- All pipe designs that include preparation for future work will include shutoff valves with blanks in lieu of installing blanks only.
- Automatic air vents shall be, at minimum, the fully automatic Spirotop or better.
- All piping will have pipe markers (wrap around) UV printed rigid plastic and thermal formed material that is designed to wrap completely around the pipe to identify both the directional flow and content of the piping system. Markers shall provide 360 degree visibility. Comply with ANSI A13.1
- All Chilled Water systems designated for year around operation will have a label on the control panel of unit indicating “Year Round Operation”; its electrical disconnect will be labeled likewise.
- Design shall include a “By-Pass & Filter” Feeder for introducing treatment chemicals into closed circulating water systems. Feeder cap closures shall be coarse thread, 2 ½ turn design rated to 300 psi. Chemical Shot feeders will not be used.
- Chilled Water piping system shall not use a mechanically grooved piping system. Polypropylene Radom (PP-R) or Cross-linked Polyethylene (PEX) shall not be specified or installed on any piping system. Copper Press Fitting technology shall not be specified or installed on chilled water piping systems.
- Active or passive chilled beam systems shall be installed only where lifecycle cost analysis indicates lifecycle savings can be recognized versus a traditional HVAC system. Active or passive chilled beam systems shall not be installed in spaces with high latent heat loads (workout rooms or kitchens), spaces with uncontrolled humidity levels (areas with uncontrolled exterior openings, building entries, or unconditioned hallways), spaces with high ceilings (ceilings in excess of 14’), or spaces that do not allow air recirculation (hazardous laboratory spaces, shooting ranges, process applications, or some healthcare occupancies).

7.2.4 Condenser Water Systems

- All designs for cooling towers shall include “side stream” media-type filters, sized for system capacity. Side stream filters for year-round towers shall be installed inside or protected from freezing.
- All metallic cooling towers shall be equipped with stainless steel cold water basins and structural members internal to the basins.
- HDPE, FRP, or other nontraditional plastic-style cooling towers shall be considered for installation only where lifecycle cost analysis indicates the potential for lifecycle savings over traditional metallic cooling towers.
- All designs shall locate Cooling Towers at least 100 feet from any building when located on the ground. When installed any place else the cooling tower will located 50 feet away from any air intake or exhaust vent.
- All metallic exterior condenser water lines and associated hardware that are not specifically in the design to be insulated shall be indicated on the drawings to have field primer and protective paint coatings applied to prevent corrosion.

7.2.5 Direct Expansion (DX) Systems

- All designs will include manufacturer recommended low ambient packages for systems that are required to operate at 55 Deg F outdoor temperature or below.
- Manufacturer equipment must be identical components between mechanical systems, with standardized components across vender product line.
- Evaporator and condenser unit models shall be paired according to manufacturer's recommendations and shall be of the same manufacturer.

7.2.6 Decentralized Unitary HVAC Equipment – Controls

Unitary HVAC systems equipped with factory installed controls shall have self-contained control packages with no interconnection to a facility Industrial Control System (ICS). Where user design requirements or regulatory guidance such as AT/FP, emergency HVAC shut-off, energy conservation, energy auditing, or specific design requirements defined elsewhere within the BFS require connection to a facility ICS, those connections shall be provided at the simplest level of interaction to satisfy the requirement(s). When a BACnet or LON interconnect is required, the designer must meet the specifications defined in section 7.6 for Energy Management & Control Systems (EMCS) and the most current version of Engineering Technical Letter (ETL) 11-1 *Industrial Control Systems Information Assurance Compliance*. **Unitary HVAC systems requiring Direct Digital Control packages at a level of sophistication considered Platform Information Technology (PIT) as defined in ETL 11-1 are not permitted** unless those control systems are approved by the Air Force Designated Approving Authority (AF-DAA) and indicated on the CE Portal Platform IT Dashboard specifically for WPAFB. A copy of the most current Platform IT Dashboard can be requested through the 88 CE Design Manager.

- 7.2.6.1 Approved decentralized HVAC systems with self-contained factory installed Direct Digital Control assemblies shall provide panel-mounted indication of the operating system status for diagnostics and safety alarms, supply-air temperature set point, zone temperature set point, supply-air pressure set point, economizer minimum position set point, supply-air pressure, and high-limit set point. Time-of-day control shall cycle unit on and off through night-heat and morning warm-up cycles.
- 7.2.6.2 A Microprocessor Control Panel shall be provided to allow viewing and changes to all configuration, operation, and maintenance control parameters by field technicians. The need for computers, software, or unique interface devices to view or change control parameters is not permitted.
- 7.2.6.3 Control interconnections made between a unitary HVAC control system to an approved Energy Monitoring and Control System (EMCS) Industrial Control System (ICS) listed in section 7.6 shall be made at the simplest level of the following two options:

- A. SIMPLE – Use of a general purpose relay or factory provided dry contacts to provide remote schedule operation. Interface relay to provide indication of fault condition with unique diagnostic code.
- B. PLATFORM IT – ASHRAE Standard 135 BACnet connections to EMCS ICS for real-time monitoring and modifications to set points, fan start/stop, and system operation to include but not limited to monitoring outdoor air damper position, supply and space air temperature and humidity, occupied and unoccupied operations, constant and variable motor loads, variable-frequency drive operation, cooling load, economizer cycles, and air-distribution static pressure and ventilation air volume.

7.2.6.4 BACnet or LON compatibility is defined as the connection of a unitary HVAC microprocessor DDC system to a facility ICS system listed in section 7.6 providing indication and control to the EMCS ICS. All BACnet programming, commissioning, configuration, and modification shall be through the EMCS ICS software. A BACnet device that requires proprietary software to install or to configure setup parameters of the interface is not permitted.

- 1. All necessary documentation, configuration information, configuration tools, programs, drivers, and other software shall be licensed to and otherwise remain with the Government such that the Government or their agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence of the manufacturer.

7.2.6.5 Variable Refrigerant Flow (VRF) or Variable Refrigerant Volume (VRV) control systems are not approved for use in facility HVAC. The only design considerations approved for VRF/VRV shall be for stand-alone systems required for tenant owned/maintained server equipment, or when a VRF/VRV can replace multiple DX split systems required for air conditioning of 88 CG computer rooms. The VRF/VRV system shall be independent of the facility HVAC system and the design should attempt to locate computer rooms one above the other on multi-floor facilities to limit refrigerant line lengths.

7.2.7 Variable Frequency Drives

Manufacturer equipment must be identical components between mechanical systems, with standardized components across vender product line. Device shall be combination VFD and Disconnect with Bypass for each motor. Have cover mounted controls including a Hand-Off-Auto switch, manual speed control and drive-bypass switch.

7.2.8 Humidifiers

- Self-contained Electric Steam Humidifier, Dristeem Vaporstream or better.

- Design shall provide proper length downstream of humidifiers to absorb humidification of vapor trails.
- Alphanumeric function and servicing displays with keypad programming and adjustment
- Self-Test diagnostics on start up
- Automatic drain down after three days without a call for humidification
- Building Management interface capability with EMCS DDC controls.

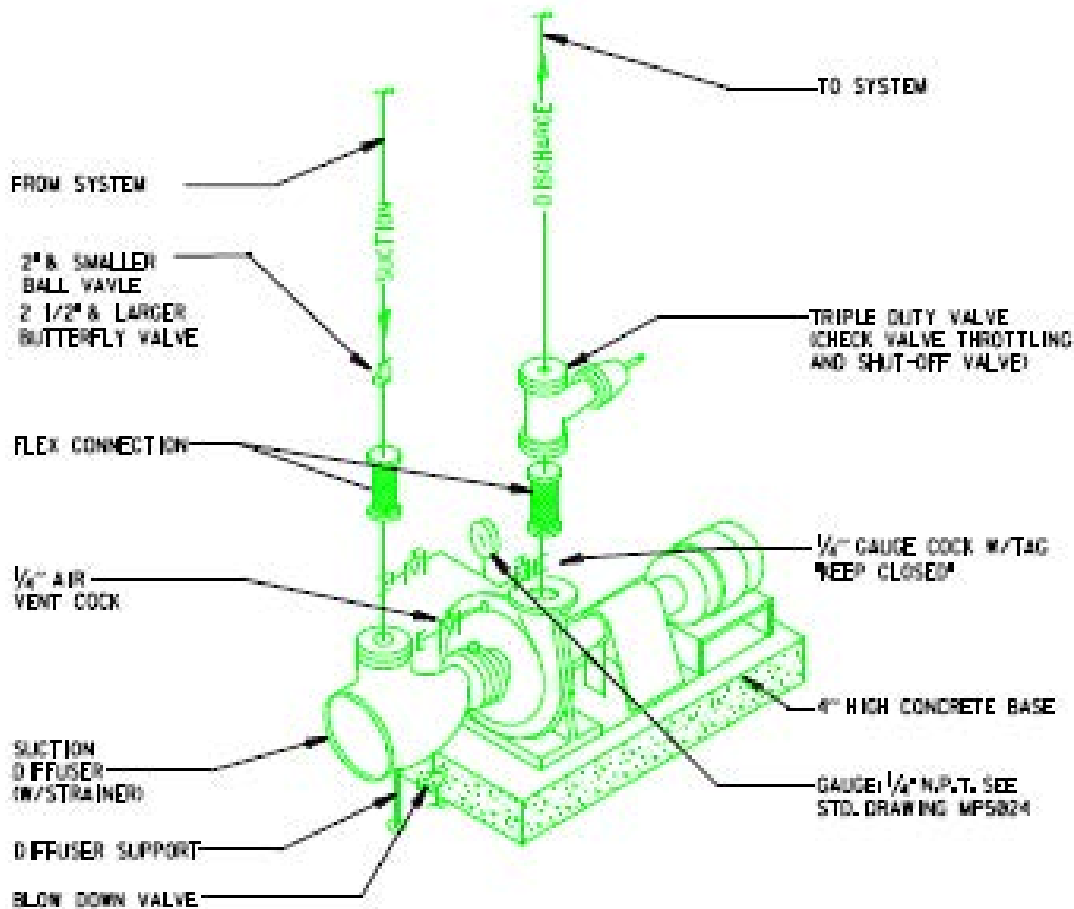
7.2.9 Pumps

Accessory components required on all pump installations shall include Inlet pressure, Outlet pressure, and Differential pressure station with gauge. Ball Valves on all vents, drains, and water lines under $\frac{3}{4}$ ". Triple Duty Valve, Strainer, and Thermometers with wells on Supply and Outlet. Pump status will be monitored by current sensor of the motor, not by differential pressure switches.

All vibration eliminators, flexible connectors, expansion joints installed on HVAC chilled water and hot water systems shall be braided metal connectors, rubber shall not be used. To include those devices provided as part of a factory built pumping package.

Chilled Water

- All chilled water systems designated as comfort cooling can be designed as single pump configuration. Backup pump not required.
- All chilled water systems designated as Critical Cooling or Process Cooling systems will have at least 1 primary chilled water pump with 1 backup pump for Lead/Standby operation.
- Lead pump will alternate every 168 hours.
- Tag Examples: CHWP-1 and CHWP-2



Circulation Pumps

- All circulation pumps for domestic hot water systems designated as Critical for processing systems will have at least 1 primary water pump with 1 backup pump for Lead/Standby operation.
- Tag Examples: DHWP-1 and DHWP-2

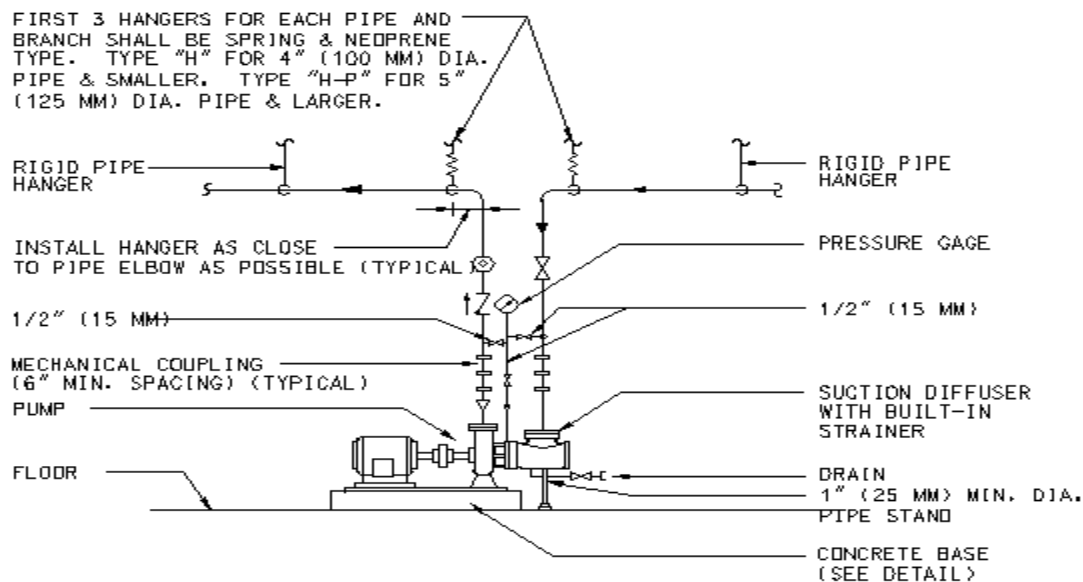
Condenser Water

- All condenser water systems for designated Critical Cooling or Process Cooling systems will have at least 1 primary chilled water pump with 1 backup pump for Lead/Standby operation.
- Tag Examples: CWP-1 and CWP-2

Hot Water

- All hot water systems will have at least 1 primary hot water pumps and 1 backup pump with Lead/Standby operation.
- Lead pumps will alternate every 168 hours.

- Tag Examples: HWP-1 and HWP-2
- Design shall include a “By-Pass & Filter” Feeder for introducing treatment chemicals into closed circulating water systems. Feeder cap closures shall be coarse thread, 2 ½ turn design rated to 300 psi. Chemical Shot feeders will not be used.



TYPICAL PIPING CONNECTIONS TO FLOOR MOUNTED SINGLE SUCTION WATER PUMPS

NOTES:

SEE SPECIFICATION SECTION "PUMPS" FOR Y STRAINER OPTION

DESIGNER'S NOTE:

CHECK VALVE IS OPTIONAL FOR SINGLE PUMP. EXCEPT FOR COOLING TOWER PUMP. USE THIS DETAIL ONLY FOR PUMPS. IN A MECHANICAL BUILDING WHERE POSSIBLE VIBRATION WILL NOT BE OBJECTIONABLE OR WHERE APPROVED BY VA. LIST APPLICABLE PUMP NUMBERS UNDER THE DETAIL TITLE.

7.2.10 Miscellaneous design requirements

- Construction Over Buried Utilities: New construction shall not be placed over existing buried water, sewer, heating, electric or telephone utilities, except in extraordinary situations and only if special provision is made for maintenance access. In no case shall any construction be placed over existing POL or natural gas tanks or lines.
- Refrigerants: Provide refrigeration equipment that meets the requirements defined in the UFGS, with the exception of HCFC-22 (R-22) refrigerant. Contract documents shall clearly state the use of HCFC-22 refrigerant shall not be permitted. Provide refrigerant recovery as per WPAFB Specification Section 02091.

- It is prohibited to procure facility systems scheduled to remain in the Air Force inventory beyond 1 January 2020 that requires Class II ODS in their operations or maintenance (i.e. HCFC-123 chillers).
- All systems designed for remote start/stop capability through the DDC control system will have an adhesive label (Black on Yellow) on its electrical start/stop station that indicates

***** CAUTION *****
 Unit can be started or stopped remotely
 Notify EMCS at 656-0360 prior to any work.
 Shut off at disconnect prior to entry

7.3 Heating Systems

7.3.1 WPAFB has three main heating plants. A breakdown of the areas they serve is as follows:

- Facility 31240 serves a majority of Area A with four systems: System "A" supplies high-temperature hot water (HTHW) to the Kittyhawk area. "C" System supplies HTHW to Facility 10271 and 10840 (Base Hospital) where it is converted to steam. This steam, in turn, is supplied to most of South Area A. The Base is slowly converting the individual buildings on the "C" system to HTHW service. Facility 10271 will eventually be phased out. For this reason, all new heating coils shall be hot water coils.
- Facility 34019 provides HTHW to the West Ramp facilities.
- Facility 20770 provides steam to all of Area B.
- Facilities 31240 and 34019 do not operate during the summer cooling season. Facility 20770 provides steam to a limited number of buildings in Area B during this time. The government must approve all use of steam during the summer cooling season.

Note: Base steam shall not be used directly for humidification due to water treatment strategies.

7.3.2 The WPAFB standard for the installation of new or replacement of existing HTHW or steam distribution lines is for the lines to be installed in concrete shallow trench systems. As much as feasible, the trench systems shall be located such to allow the tops to be used as sidewalks or underneath paved surfaces. Thermal expansion compensation shall occur using expansion loops and the geometry/flexibility of the respective pipe system. Use of mechanical expansion joints for thermal expansion must be approved in advance by the Civil Engineering Mechanical Infrastructure Engineer. Mechanical expansion joints are approved for use in the steam tunnels in Area B. Direct Buried steam or HTHW piping systems have less service life than shallow trench systems. For direct buried systems, the following constructed specification shall be used for maximum system service life:

- Only Class-A, Fusion Bonded Epoxy (FBE) coated systems shall be installed. Minimum wall thickness for pressure class-150 carrier pipes shall be SCH-40. Carrier pipe shall be insulated with calcium silicate. Pipe casings shall have a minimum wall thickness of 10-gage. Casings shall have a 20-mil to 25-mil thick coating of fusion bonded epoxy. Casing weld joints shall be coated with a 25-mil to 35-mil thick high temperature (250° F/121°C) epoxy coating such as DENSO Portal-7950, after proper surface preparation has been accomplished.
- Fiberglass and high density polyethylene (HDPE) casings shall not be used. Both offer no protection to ground hog and impact damage. Galvanized casings shall not be used for direct buried systems. Zinc becomes cathodic at temperatures above 160°F (71.1°C) in moist environments and corrosive to steel.
- All metallic direct buried piping systems shall have a cathodic protection system designed and installed under the supervision of a certified National Association of Corrosion Engineers (NACE) Cathodic Protection Specialist. Polyurethane coatings, HDPE heat-shrink sleeves, fiberglass and HDPE casings do not support cathodic protection of steel casings or carrier piping. These products shield cathodic protection currents and shall not be used to construct any direct buried steam/HTHW piping system.
- All direct buried piping to be holiday tested to NACE Standards RPO402-2002 and SPO490-2007 under the supervision of the NACE Protection Specialist.

7.3.2.1 Mechanical expansion joints used in Area B are to be an externally pressurized, flanged connections with ¾" trap connections as manufactured by Senior Flexonics Pathway, Model HSX with ranges of either 4" or 8".

7.3.2.2 Gaskets for flanged joints for cathodically protected steam/condensate, HTHW and direct buried conduit system shall be manufactured from pure PTFE resin combined with inorganic fillers homogeneously dispersed throughout the compound in accordance with ASTM F104, F452111-M6, such as Durlon Style 9000 as manufactured by Durabla Manufacturing Corporation, or FluoroGreen E-600, or approved equal, suitable 232 degrees C/3.6 Mpa (450 degrees F/520 psi). Gasket thickness shall be 0.0025MM (1/16"). All gaskets to be installed per manufacturer's instruction.

Gaskets for flanged joints for HTHW/Steam and Condensate systems, where cathodic protection is not required shall be self-centering spiral wound type, with metal winding material of the same metallurgy as piping and flanges with spiral wound sealing element and a solid metal outer ring in accordance with ASME B16.20 – 1993, such as TEADIT Style 913 with Grafoil filler, Flexitallic or

approved equal, suitable 232 degrees C/3.6 Mpa (450 degrees F/520 psi) HTHW service. All gaskets to be installed per manufacturer's instruction.

Corrosion Control Isolating Flange Kits shall be provided for all flanged connections to underground systems (direct buried conduits) and for all flanged connections to existing underground systems in pits and buildings. Corrosion Control Isolating Flange Kits shall consist of a filled polytetrafluorethylene (PTFE) gasket 0.0025MM (1/16") thick Durlon 9000 or FluoroGreen E-600, as described above, double NOMEX bolt washers and NOMEX type sleeves, sized per pressure class and flange size.

- 7.3.2.3 Insulation Jackets for Steam and HTHW Distribution Pipe above ground will be aluminum jackets. Aluminum jackets shall be smooth sheet and shall meet the requirements of ASTM B 209 Alloys 3003, 3105 or 5005. Aluminum jackets shall be not less than 0.016 inch thick and shall be secured with aluminum or Type 304 annealed stainless steel securing bands. Securing bands shall be at least 1/2 inch wide for jackets with less than a 20 inch circumference and 3/4 inch wide for jacket circumferences 20 inches and greater. Aluminum jackets shall be used with calcium silicate insulation.

Insulation Jackets for Steam and HTHW Distribution Pipe in shallow trench and tunnels can be either aluminum or a poly jacket. Aluminum jackets will be used at access points plus 3 feet on either side of the access to the tunnel or shallow trench. Aluminum jackets will also be required in high traffic areas or over pipe that is susceptible to damage by normal traffic. High traffic areas are intersections of tunnels, branches of the tunnels, at tunnel roof access points and other locations where personnel are likely to be passing between pipes, passing over pipes or stepping on pipes.

7.3.3 UFC 3-430-01FA Design

Heating and Cooling Distribution Systems, and UFC 3-430-09 Design: Exterior Mechanical Utility Distribution shall be used in the design of steam and HTHW distribution pipe systems. Any conflicts between the two manuals shall be brought to the attention of the Government for resolution.

- 7.3.4 Sump pumps installed in steam pits, steam tunnels or shallow trenches shall be rated for 200 °F.
- 7.3.5 The steam tunnels in Area B are for the steam and condensate distribution lines, installation of other utilities such as water, sanitary sewer, storm sewer, communication, etc. is by exception only and must be approved in advance by the Civil Engineering Mechanical Infrastructure Engineer.

- 7.3.6 Isolation valves greater than or equal to 4" and mechanical expansion joints shall be insulated using removable/reusable insulation covers similar to Mega Wrap™ covers as manufactured by Custom Insulation Fabricators, Evansville, IN.
- 7.3.7 Isolation valves, for the steam and condensate distribution systems, greater than or equal to 4" shall be a triple off-set butterfly valves. The valve shall feature a field replaceable seat, 316 SS disc, a cast yoke assembly and be similar to the Type MAK valve as manufactured by Adams Valve, USA.
- 7.3.8 Mechanically grooved piping systems shall not be permitted on any type of heating system. Neither Polypropylene Radom (PP-R) nor Cross-linked Polyethylene (PEX) shall be specified or installed on any piping system. Copper Press Fitting technology shall not be specified or installed on hot water piping systems.
- 7.3.9 All piping will have pipe markers (wrap around) UV printed rigid plastic and thermal formed material that is designed to wrap completely around the pipe to identify both the directional flow and content of the piping system. Markers shall provide 360 degree visibility. Comply with ANSI A13.1.
- 7.3.10 All Pre-engineered Underground Heat Distribution systems shall have steel casings with Fusion Bonded Epoxy (FBE) coating. The use of FRP casings is prohibited.
- 7.3.11 All new construction and major renovations shall use natural gas heat, unless approved otherwise by CE, based on life-cycle cost analysis.
- 7.3.12 All steam pit and concrete shallow trench entry points shall have 48" x 48" double door hatches, at a minimum. Hatches shall have 1/4" thick extruded aluminum diamond plate covers with type 316 stainless steel assembly hardware. Hatch shall be rated to meet AASHTO H-20 wheeled load rating. Bilco model J-AL H20 or equal. Install in steam pits, and anywhere an expansion joint or valve is installed in a concrete shallow trench.

7.4 Natural Gas

Natural Gas is supplied to WPAFB through thirteen meter/regulating stations owned by Vectren Energy. WPAFB owns and maintains all gas main and service lines fed from these thirteen meter/regulating stations. WPAFB is classified as a Local Distribution Company (LDC) in regards to gas distribution. WPAFB is required to comply with 49 CFR part-192 (Pipeline and Hazardous Materials Safety Administration) regulations.

- 7.4.1 During preliminary design, all connections to a WPAFB gas main or service line shall be approved by the Government.
- 7.4.2 All new or modified gas services shall contain a standard gas meter with an analog read out along with a digital output compatible with the Base EMCS system for remote

reading. Meter digital output shall be connected to a facility EMS panel if available. Coordinate this effort with Civil Engineering Requirements and Optimization Section.

- 7.4.3 All new or modified gas service lines shall contain an “Excess Flow Valve” (EFV) in compliance with 49 CFR part 192.381. An EFV interrupts the flow of gas if the service line is damaged by excavation activity or gas service riser components suffer damage.
- 7.4.4 All new gas mains or service lines shall be constructed of DR-11 (or greater) polyethylene unless the pipeline’s MAOP is over 100-PSIG (49 CFR part 192.123). Coated carbon steel pipe shall be utilized for all pressures over 100-PSIG.
- 7.4.5 49 CFR part 192.513 shall be followed for pressure testing any new, modified, placed back into service or up-rated polyethylene gas pipeline. Pressure test results and the established MAOP for the pipeline shall be provided to Civil Engineering Requirements and Optimization Section, for permanent records keeping (49 CFR part 192.517).
- 7.4.6 All connections between or to a polyethylene gas pipe shall be performed by the “butt-fusion” or “electro-fusion” process. Only “qualified” persons shall perform electro-fusion or butt-fusion joints (49CFR pat 192.285). No “stab” or mechanical type joints/fittings are allowed.
- 7.4.7 Insulated “copper clad” steel core tracer wire shall be installed on all polyethylene gas piping. This includes gas piping install by horizontal directional drilling (HDD). Tracer tape shall not be installed. A locate or conductivity test shall be performed on the trace wire after installation.
- 7.4.8 Polyethylene piping shall not be installed in gas meter, valve vaults or pits or where exposed to the atmosphere (violation of 49 CFR part 192).
- 7.4.9 All gas service risers shall be of the “anodeless” type.
- 7.4.10 All maintenance and repair tasks are required to be accomplished by persons “OQ” qualified per the Base “OQ” program.
- 7.4.11 All steel gas piping designs shall have a coating and cathodic protection system approved by the Base Corrosion Engineer.
- 7.4.12 A minimum of two natural gas fired boilers shall be used to provide winter heating load, unless otherwise approved by 88 CEG Design Manager. Boilers shall be sized per UFC 3-410-01.
- 7.4.13 Natural gas fired heating boilers shall have stainless steel or copper heat exchangers.

7.5 Plumbing

The A/E shall provide plumbing designs in accordance with UFC 3-420-01 Plumbing Systems, which adopts the latest version of the International Plumbing Code. Provide access to valves, backflow prevention devices, etc. for maintenance personnel. Provide manual flush valves, not automatic flush valves for urinals and water closets. DO NOT provide waterless urinals. Provide manual lavatory faucets, not automatic lavatory faucets. Provide proper backflow and cross-connection prevention appropriate for the hazard involved per WPAFB Specification Section 22 00 01. All reduced pressure type devices shall be manufactured by Watts Regulator Company, or equal.

The Base shops prefer that the following plumbing fixtures/fittings/products/manufacturers are specified where possible:

1. Provide manual flush valve water closets and urinals. Tank-flush fixtures are not allowed. Automatic flush systems are not allowed.
2. Water closets shall use 1.6 gpf and urinals shall use 1.0 gpf.
3. Wall-hung water closets are acceptable but must be installed with an accessible chase that is at least four feet wide and the carrier shall have a rating of at least 700 pounds.
4. Floor-mounted water closets are acceptable but piping through concrete floors must be sealed with Rockite Hydraulic Cement.
5. Automatic faucets are not allowed.
6. Provide cast traps for "P" traps, brass (McGuire) with bottom clean-out.

Note: Although the above items/manufacturers will be specified in the design, construction submittals of "Or Equals" will be reviewed and accepted if equal.

7.5.1 All piping will have pipe markers (wrap around) UV printed rigid plastic and thermal formed material that is designed to wrap completely around the pipe to identify both the directional flow and content of the piping system. Markers shall provide 360 degree visibility. Comply with ANSI A13.1.

7.5.2 Above ground plastic domestic water piping and fittings shall not be specified or installed. This includes polyethylene (PE), polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), and polypropylene (PP).

7.5.2.1 For cross-linked polyethylene (PEX), use red colored pipe for hot water, blue/white colored pipe for cold water. Follow ASTM F877 and manufacturer's recommendation for proper installation.

7.5.3 Copper Press Fitting technology shall not be used on any water system that is in the proximity of critical equipment that would be subject to water damage in the event of a leak. Copper press fitting technology shall only be allowed for use on domestic water systems where access to the piping is possible without removing walls or hard ceilings.

- 7.5.4 Insulated steel core, copper plated tracer wire shall be installed on all exterior direct buried PVC/HDPE water lines. The wire shall be terminated at the isolation valves or at the facility in a cast iron test station. Test station shall have "WATER T.S." cast into the test station lid. A locate or conductivity test shall be performed on the tracer wire after installation.

7.6 Energy Management Center (EMC) and Industrial Control Systems (ICS)

The Energy Management Center (EMC) is located in Area A Building 22 comprising of three different subsystems forming the Bases of the centralized front-end. Responsibility for maintaining the operational readiness of the EMC falls upon the 88 CES/CEOER Requirements and Optimization Section. The three subsystems currently include:

1. A Supervisory Control and Data Acquisition (SCADA) central computer system for monitoring the Base electrical power grid and substations.
2. An Energy Management Control System (EMCS) for HVAC and other local building Industrial Controls systems.
3. A Advanced Meter Reading System (AMRS) for real-time monitoring and data recording of facility electric power usage.

7.6.1 Supervisory Control and Data Acquisition (SCADA)

The central Supervisory Control and Data Acquisition system resides on its own network independent of the Base-wide area network. Its front-end is located within the EMC consisting of the SCADA Server and an operator workstation. Additional operator workstations are locate in the Patterson Field Electric Shop in building 30022 and the Wright Field Electric Shop in building 20890.

7.6.2 Energy Management Control System (EMCS)

The Energy Management Control System (EMCS) in building 22 is a large Level C system. The current configuration of the EMCS is limited to two manufacturer systems. The Johnson Controls Inc. Metasys Extended Architecture System (MSEA) supervisory and facility controls system, and the Siemens Talon (BacNet) supervisory and facility controls system.

- 7.6.2.1 New connections to EMCS: All connections shall be made through the CE Virtual Local Area Network (VLAN). No ICS devices are permitted on any other network. Two LAN drops are needed at each network controller panel. One dedicated to the network controller and one for the service technicians use for connection to the domain. Annotate CE Network connection locations on project drawings, and coordinate installation with other disciplines.

- 7.6.2.2 As stated the EMCS component of the EMC consists of a Johnson Controls Metasys and Siemens Talon Controls system front-end. All project designs will

provide 100% interface between the local building ICS and the existing EMCS Metasys Controls or Talon Controls system without the use of third party interface hardware/software.

7.6.2.3 Prior to design, the Designer of Record shall consult with the ICS Managers to obtain current information regarding DDC manufacture selection and facility DDC connectivity requirements to the current EMC. The design shall include all requirements that will permit communications and monitoring with the existing EMC. Single manufacture DDC systems/controls shall be used for individual facilities and multiple facilities (complex) utilizing a central HVAC plant; multiple manufacturer systems/controls is not permissible.

- ICS connection to the EMC is mandatory to meet the Energy Policy Act of 2005 (section 103), Energy Independence and Security Act of 2007 (section 434), AFMC A7C memorandum *DOD Facilities Metering Installation Initiative* (10 July 2009), and DODI 4170.11 *Installation Energy Management* to maintain compliance with regulatory conservation measures.
- Control System Contractor personnel with responsibility for installation, modification, or accessing of Industrial Control System shall do so only from government provided equipment. CSC personnel shall have a current network accessible Common Access Card (CAC) with User privileges on the base domain. If CSC personnel require access to an ICS server platform a Privileged user credentialing is required. Additionally a completed System Access Authorization Request (SAAR) package shall be submitted and maintained by the base ICS/IAM before access shall be provided to an ICS system or the CE VLAN.
- When the design calls for a local Human Machine Interface (HMI), or an Operator Workstation (OWS), all equipment shall be government furnished. When the design calls for touchscreen interface, coordinate hardware selection with 88 CES/CEOER. Touchscreens shall be internally configured as part of the control system and not directly connected to the CE VLAN.

7.6.2.4 ICS functions will not be split between two different EMCS front-end systems to monitor the same facility. When an existing legacy DDC control system is already utilized within a facility, the next generation of the manufacturers DDC controls shall be installed. The EMCS interface will remain a single seat operation.

7.6.2.5 Special Access Program Facilities; JAFAN 6/9 {or current guidance} defines energy management systems (EMS); which provide power, telephone, lighting, and HVAC for the SAPF (which often reside outside the SAPF perimeter) as a Critical Infrastructure Item. Designers shall coordinate with the government Program Security Officer (PSO) on all new construction and renovation projects regarding the EMS system and connectivity on the Base-wide EMC network.

Nothing in the JAFAN shall be construed to contradict or inhibit compliance with the law or building codes. PSOs shall work to meet appropriate security needs according to the intent of the JAFAN manual at acceptable cost.

7.6.3 Advance Metering Reading System (AMRS):

The central Advance Metering Reading System (AMRS) is a large Level C system and currently connected to several facilities and electrical substations through the Base-wide area network and dedicated telephone circuits.

7.6.3.1 New connections to the AMRS: Connections shall be made through the CE Virtual Local Area Network (VLAN) only. One LAN drop shall be provided at the electrical panel containing the power meter, to include power meters located in Special Access Program Facilities.

7.6.3.2 As stated the AMRS proponent of the EMC consists of a Schneider Electric Square D Powerlogic front-end for electrical metering. Designers shall verify requirements in 2014-2015 as the transition period between Schneider Electric Powerlogic decommissioning and Schneider Electric StruxureWare Power Monitoring (SPM) implementation.

7.6.3.2.1 The Schneider Electric System Manager, currently monitors individual electrical power consumption from specific facilities/areas. See *Section 9.7, ELECTRICAL METERING* for specific electrical consumption metering requirements.

7.6.3.3 All conservation metering (Water, Air, Gas, Electric, Steam) shall be connected to the Energy Management Center (EMC) through the existing Schneider Electric Monitoring system and configured for the appropriate WAGES meter in the device tables for data archiving. When the Powerlogic system is not existing then all conservation metering shall be brought back through the existing facility DDC system. The Powerlogic system is the Primary consideration, the DDC system is the alternate. Reference 7.4.2 Natural Gas and 9.7.1 Energy Metering.

7.6.4 Facility Heating, Ventilation, and Air Conditioning (HVAC) Controls

The EMCS front-end shall communicate with all locally installed facility DDC systems. All project designs shall incorporate the requirements of the BFS into the appropriate Project Specification defined in section 1.2; 23 09 23 DDC Controls for HVAC (WPAFB). All HVAC controls Request For Information (RFI) will be submitted in writing to the WPAFB Project Manager who will forward that to 88 CES/CEOER Requirements and Optimization Section for clarification and resolution.

7.6.4.1 DDC Controls Network Designs

The project's design for DDC controls cannot simply specify a requirement for an Open Protocol System such as LonWorks or BACnet. Since a control system can be comprised of components from multiple vendors the drawings and specifications must clearly address who is responsible for integrating each component into the overall control system and who will provide all the necessary set-up and programming tools for each component. (Reference WPAFB BFS APPENDIX E for additional point's detail.)

- 7.6.4.1.1 On projects where the controls network will utilize LonWorks the controls submittal will define the specific vendors device and provide their data type Standard Network Variable Types (SNVT) & Standard Configuration-Property Types (SCPT) list per component. The SNVT list will be annotated to show what SNVT's will be applicable upon installation. The UNVT & UCPT (U= User defined) list is also required if the vendors make that distinction in their data types.
- 7.6.4.1.2 On projects where the controls network will utilize BACNet devices, the controls submittals will likewise define the specific vendors device and provide the BACnet-defined Protocol Implementation Conformance Statement (PICS) per device. The PICS defines each product's capability. It begins with a product description, and details the LAN type (Data Link Layer Option) and conformance class of the device. PICS' also include the services supported, object types, and, if required in the specification, descriptions of any proprietary services or objects.
- 7.6.4.1.3 The design shall not include any new product lines for DDC controllers, sensors, accessory devices, software, firmware, or any other products used to construct the controls network with less than 2 years proven product reliability. Devices in alpha testing, beta testing, or considered prototype devices will not be used until they've entered factory production and been made available to the open market. Proven product reliability is defined as being free of factory defect, recall, or requiring mandatory upgrades to software or firmware. All software selected for the design shall be reflected as approved on the CE Portal Platform IT Dashboard specifically listed for WPAFB prior to its installation. A/E to coordinate with 88 CEG Design Manager for determination of approval status.
- 7.6.4.1.4 The design shall specify the use of application specific controllers (ASC's) and will use ASC's as field controllers on equipment for which their programming was intended. The use of general-purpose programmable controllers (GPPC's) will be approved on project-by-project bases. Designs requesting GPPC's usage must request in writing and provide with their request the programming and logic that will reside in each controller for evaluation to 88 CES/CEO.

- 7.6.4.2 All Industrial Control Systems on WPAFB are certified and accredited by the Air Force Civil Engineering Center (AFCEC). The CE VLAN is certified and accredited by the 690th Network Support Group. 88CEG has no local regulatory authority to wavier selection and implementation requirements of these two organizations. That includes the acquisition phase as detailed in the *Information Assurance Platform Information Technology Guidebook; Appendix C Platform Information Technology (PIT) Acquisition Process*. Version 1.3 or current version.
- 7.6.4.3 Energy Conservation: Provide a design that meets the minimum requirements for energy efficiency as outline in the most current ANSI/ASHRAE/ESNA Standard 90.1.
- 7.6.4.3.1 The design shall include Discharge Air Static Pressure setpoint reset on all VAV systems as specified in ASHRAE 90.1 paragraph 6.5.3.2.3.
- 7.6.4.4 DOD Minimum Antiterrorism Standards For Buildings
- Each facility will adopt UFC 4-010-01 and subsequent criteria in paragraphs B-4.1 and B-4.3 pertaining to Air Intakes and Emergency Air Distribution Shutoff of HVAC systems into the DDC controls design on all new construction projects. The A/E will incorporate user comments and requirements into the overall strategy during the conception and design phase. Local air handing units serving critical laboratory systems where cooling/heating or positive/negative pressure must be maintained to prevent unsafe conditions, the emergency shut-off shall NOT shut down the laboratory exhaust and supply fans. The building emergency shut-off to lab systems should not be connected. A separate shut-off from the general building emergency shut-off station shall be installed for these systems in accordance with B-4.3.2.criteria.
- 7.6.4.4.1 Emergency Shutdown requirements
- 7.6.4.4.1.1 The Emergency Shutdown Button (ESB) will reside in a common area, at minimum, for activation by anyone locally within the facility.
- 7.6.4.4.1.2 A shutdown point through the DDC control system shall be provided to command enabled from EMCS. The ESB status will also be monitored by EMCS.
- 7.6.4.4.1.3 Activation by either function will shut down all air distribution systems within the facility and close dampers accessible to the outside air. Neither device will be capable to override the other to reactive the system.

- 7.6.4.4.1.4 The ESB and DDC interface will be hardwired prior to any electrical device such as Hand-Off-Auto switches or safeties that would defeat the function of these devices.
- 7.6.4.4.2 ESB Station characteristic and labeling
- 7.6.4.4.2.1 The ESB station will consist of a button red in color, two positions with depression for activation, and a clear plastic non-locking cover. Two indicator LEDs will be associated with the button for local notification of activation by either the ESB or by the DDC system.
- 7.6.4.5 Load-Shedding
- The DDC HVAC control system will incorporate the following requirements into all control system designs.
- 7.6.4.5.1 Load Shed (LS) relay
- Install a set of normally closed contacts after the contacts of the aforementioned Emergency Stop Button (Ref: Section 7.6.4.4.1.4) on all air distribution systems. Label contacts as LS-1. The requirement is to allow for temporary shutdown of a system without local capability to override through the motor control center.
- 7.6.4.5.2 At EMCS provide a single graphic screen with the following functionality for all HVAC systems within the project.
- 7.6.4.5.3 Provide means to limit all air handler VFDs to 50% (adj) with single command. Displaying individual system command and status.
- 7.6.4.5.4 Provide means to place all air handlers systems into Unoccupied Mode, and command off through LS relay. Display individual system status.
- 7.6.4.5.5 Provide means to remote adjust Chillers supply water temp setpoint and Chiller demand limiter setpoint.
- 7.6.4.5.6 Provide means to globally load shed entire facility from single software command per strategy described in 7.6.4.4.1.3. This is for regional load shed capability and design will be incorporated into existing EMCS master load shed control scheme.
- 7.6.4.5.7 Each systems control panel will have indicator lamp for Load Shed enabled notification.

7.6.4.6 HVAC Water Treatment (WT) Monitoring

Cooling Tower and Boiler water treatment systems are standardized Base-wide allowing for data-logging and quality control capabilities via EMCS. Control and monitoring of cooling tower and boiler water treatment systems will be maintained by the Aquatrac AS series Water Management Controller equipment.

7.6.4.6.1 Cooling Tower WT systems will provide real-time status of condenser water pH, conductivity as TDS, and controller alarm status to EMCS. Trending will be setup in the DDC control system at a sampling rate of every 30 minutes.

7.6.4.6.2 Boiler WT systems will provide real-time status of pH, water conductivity as TDS, condensate conductivity as TDS, and controller alarm status to EMCS. Trending will be setup in the DDC control system at a sampling rate of every 30 minutes.

7.6.4.7 DDC controls minimum point list tables

Refer to DDC Point Tables Appendix E (DDC POINTS.XLS)

7.6.4.8 DDC device naming convention and tags

Enable = ENA	Chilled Water System = CHW SYS
Disable = DIS	Chilled Water Supply = CHWS
Setpoint = SET or SETPT	Chilled Water Return = CHWR
Sensor = S	Condenser Water System = CW SYS
Current Sensor = CS	Condenser Water Supply = CWS
Temperature = T	Condenser Water Return = CWR
Humidity = H or RH	Chilled Water Pump = CHWP
Discharge Air = DA	Condenser Water Pump = CWP
Supply Air = SA	Hot Water Pump = HWP
Supply Air Fan = SF	Hot Water Supply = HWS
Return Air = RA	Hot Water Return = HWR
Return Air Fan = RF	Boiler = BLR
Mixed Air = MA	Steam Generator = SG
Relief Air = RA	Heat Exchanger = HX
Exhaust Air = EA	Domestic = DOM
Exhaust Fan = EF	Cooling Tower = CT
Water Treatment = WT	

7.6.4.9 HVAC Renovation Design Projects

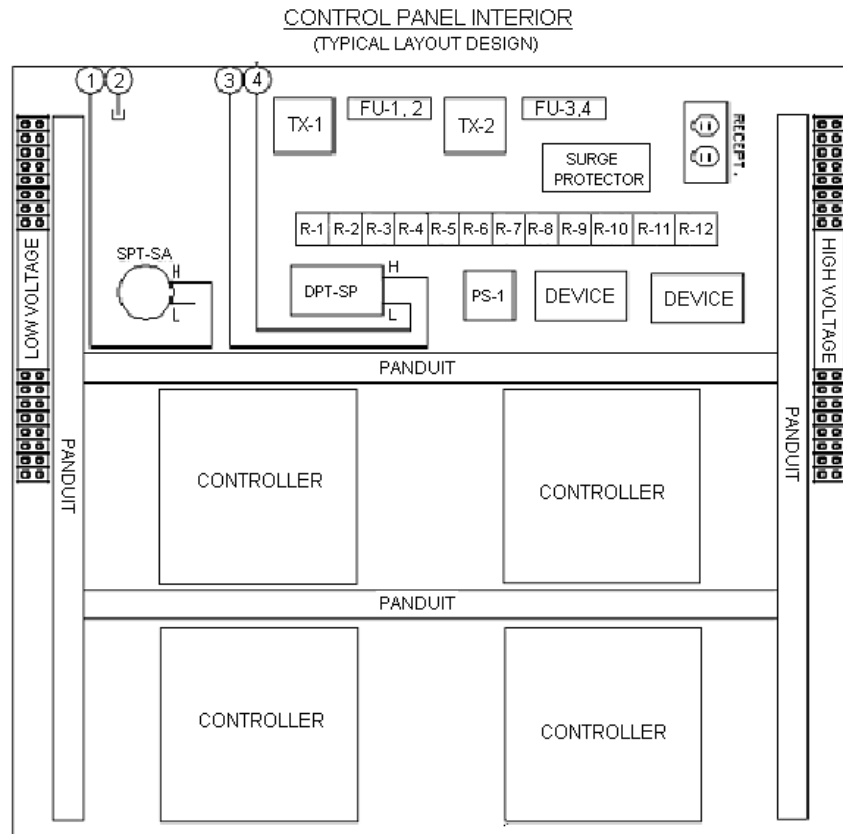
The following note shall be on all mechanical demolition drawings. “Prior to start of construction the government, 88 CES/CEOIC at 904-2431, shall be contacted and afforded the opportunity to remove any controls it deems

salvageable; especially the existing METASYS control, STAEFA control and TALON control devices.”

7.6.4.10 DDC control panel configuration

All DDC control panel layouts and construction will be consistent with established WPAFB standards and representative in Figure 7.6.4.10.3 “Controls Panel Interior”. Each control panel will have a locking mechanism utilizing the same key for each panel.

- 7.6.4.10.1 All relays, switches, transducers, and other field interface devices for equipment located within the mechanical equipment rooms, shall be panel mounted. Provide a 120VAC convenience receptacle in each panel. All electrical devices within the panels shall be wired to a numbered terminal strip. A switch shall be located inside the panel to shut off all 120VAC power. All wiring within the panel shall be run in wiring tray in accordance with NEMA and UL standards, and shall meet all local codes. Panels shall be NEMA type suitable for applications as required. Provide a final as-built control drawing, half-sized, laminated, and mounted inside of the panel door.
- 7.6.4.10.2 Control panels will be mounted allowing access from the floor to the top of the control panel without the use of ladders or lifts, with the exception of terminal VAV control panels.
- 7.6.4.10.3 Control panels requiring removable door for allowing full opening of the panel will not require the use of tools to remove the door or the need to disconnect any wiring. Except for terminal VAV control panels.



7.6.4.11 Hardware Specific Requirements

Due to the number of HVAC systems managed and maintained by the 88 CEG, some components require standardization to provide effective and economical logistic support. A local bench stock is maintained with limited resources for spare replacement parts to minimize downtime and impact to mission requirements. All products listed are the government's minimum requirements for bench stock items and any substitution must meet 100% of those requirements or exceed them. Best value pricing and competitive pricing through competition is still encouraged.

- 7.6.4.11.1 Control Valve Actuators on air handling systems. Actuators for control valves will be Electronic Rack and Pinion mounting design utilizing direct-coupled motor(s).
- 7.6.4.11.2 FanCoil and VAV reheat control valves/actuators shall be Belimo B2 or B3 series ball valves with actuator. Terminal unit valves, 1/2 inch to 1 inch: Valves shall be sized for a 3 to 5 psi drop. Valve body shall be nickel-plated brass, rated at 125 psig.

- 7.6.4.11.3 Clamp on sensors for High Temp Hot Water systems: Sensor shall be clamp on Platinum, 1000 ohm, -94 to 932 Deg F, Minco Products S101731-PF-2-G40.
- 7.6.4.11.4 High Temperature Hot Water Emergency Shutoff Valves: Valves shall be high performance ball valve, hard graphite seated, 3H Trim, suitable for 500 deg. at 500 psi. Actuator shall be 2-position electric failsafe type.
- 7.6.4.11.5 High Temperature Hot Water Control Valves: Valves shall be rated to 428 deg. F and 500 psi, and shall be sized for a 3 to 5 psi pressure drop.
- 7.6.4.11.6 Water treatment for cooling towers and boiler system. Aquatrac AS series Water Management Controller.

7.6.5 Economizer Control Mode

All economizer designs shall be at minimum Differential Dry Bulb. The option for Electronic Enthalpy control is the only exception. These are the only two of the six defined in ASHRAE 90.1 adopted by WPAFB.

- 7.6.5.1 The economizer mode will be enabled whenever the Outside Air Temperature is less-than the Return Air Temperature by 4 Deg F or more. This is true regardless of when the mechanical cooling is enabled. As long as the Outside Air Temperature is cooler than the Return Air Temperature it's more economical to cool with the outdoor air minimizing the load on the mechanical cooling if energized.

7.6.6 Lighting Control

The indoor and exterior lighting control design shall incorporate the Mandatory Provision of ASHRAE 90.1 section 9.4. for Lighting. Where the design calls for Automatic Lighting Shutoff and Time-Scheduling Devices, the designer shall incorporate that control logic into the building automation system installed or utilized for the HVAC DDC control system. Automatic Lighting Control will be an extension of the Siemens Talon or Johnson Metasys and not an independent third party control system.

- 7.6.6.1 Occupied and Unoccupied time schedules for Lighting Control shall correspond with the same time schedules of the HVAC system serving area. This will limit the duplication of programming resources to achieve similar requirements between sub systems.
- 7.6.6.2 Consideration in the lighting design shall be given for temporary override by the building occupants through the same HVAC temporary override device installed with the building automation system. The thermostat override button is available on most DDC thermostats. This device can allow for lighting activation

concurrently with the temporary call for HVAC activation through a single device.

7.6.6.2.1 Temporary time period shall be adjustable via the DDC software with default duration programmed for 2 hours.

7.6.6.3 Refer to ELECTRICAL section 9.6 for requirements not directly associate to the DDC controls portion.

7.6.6.4 Information Assurance Note: All control systems require product specific certification and accreditation (C&A) for hardware and software. The design shall not call for the integration of a separate Lighting Control subsystem into the HVAC building automation system network.

7.6.6.4.1 Where a unique design requirements calls for exceeding the Mandatory Provision of AHSREA 90.1, requiring an application specific lighting controller or functionality not available through the HVAC DDC system (i.e. day light harvesting, space dimming of 24hr areas), those lighting controllers shall be ASHRAE 135 BACnet compliant and brought into the HVAC DDC system network.

7.6.7 All software and graphics will meet the current EMCS standardization for data structure format and graphics templates for EMCS systems as developed by 88 CES/CEOER Optimization & Requirements Section, and verified by 88 CES/CEOIC EMCS Engineering Technician, Building 30022, WPAFB.

7.7 Corrosion Control

Implement AFI 32-1054 (Corrosion Control) to meet requirements of AFD 32-10 (Installations and Facilities).

7.7.1 Cathodic Protection

Per AFI 32-1054, all metallic infrastructures in contact with soil or water shall have cathodic protection. Additionally, all cathodically protected structures shall be coated with an approved below grade coating. These National Association of Corrosion Engineers (NACE) listed recommended practices shall be followed:

- NACE RP0169-2002 – Control of External Corrosion on Underground or Submerged Piping Systems
- NACE RP0187-96 – Design Considerations for Corrosion Control of Reinforcing Steel in Concrete
- NACE RP0193-2001 – External Cathodic Protection of On-Grade Carbon Steel Storage Tank Bottoms

- NACE RP0196-2004 – Galvanic Anode Cathodic Protection of Internal Submerged Surfaces of Steel Water Storage Tanks
- NACE RP0200-2000 – Steel Cased Pipeline Practices
- NACE RP0286-2002 – Electrical Isolation of Cathodically Protected Pipelines
- NACE RP0285-2002 – Corrosion Control of Underground Storage Tank Systems by Cathodic Protection
- NACE RP0274-2004 – High-Voltage Electrical Inspection of Pipeline Coating
- NACE RP0303-2003 – Field-Applied Heat-Shrinkable Sleeves for Pipeline
- NACE RP0388-2001 – Impressed Current Cathodic Protection of Internal Submerged Surfaces of Carbon Steel Water Storage Tanks
- NACE RP0490-2001 – Holiday Detection of Fusion Bonded Epoxy External Pipeline Coatings of 10 to 30 mils thickness
- NACE RP0572-2001 Design, Installation, Operation and Maintenance of Impressed Current Deep Groundbeds

7.7.2 All cathodic protection designs shall be performed by a NACE accredited “Cathodic Protection Specialist”. This individual shall have a minimum of five years’ experience in the design of cathodic protection systems for the specific structure being protected. System design shall be based on tests specific to the construction site. These tests shall include, but are not limited to, soil/water resistivity, pH, chemistry/corrosiveness, etc.

7.7.3 Relevant sections pertaining to corrosion control and the design and installation of cathodic protection systems from the following codified Federal and State regulations shall be followed:

- 49CFR part 192 (Gas Lines, Requirements for Corrosion Control)
- 40CFR part 280 (Underground Storage Tanks , Petroleum)
- Ohio BUSTR (Corrosion Control of UST’s)

7.8 Water Treatment

7.8.1 Industrial Water Treatment (IWT)

IWT chemicals, equipment and procedures for steam/hot water heating and chilled water cooling systems shall be designed/specified by an IWT expert. This person shall either be certified by the National Association of Corrosion Engineers (NACE) as a Chemical Treatment Specialist, Sr. Corrosion Technologist, Corrosion Specialist or a Chemist/Chemical Engineer having five or more years’ experience designing IWT systems.

NACE Standard RP0300-03/ISO 16784-1 “Corrosion of metals and alloys – Corrosion and fouling in industrial cooling water systems” shall be utilized as the baseline standard for all IWT designs.

All steam/hot water heating or chilled/condenser water cooling type systems, of either closed or open loop design, shall utilize treated water to prevent system scaling and corrosion.

Hydro tested systems shall be completely drained and flushed and not refilled until the final “flush water” tests clear of construction contaminants (e.g. oils, dirt, cuttings, rags and other debris). Hot and chilled water systems shall be filled with clean “potable” water. Civil Engineering’s IWT contractor will provide “third party” testing of flushing and final fill water to insure piping/equipment is adequately flushed. After a system passes final flush testing, it shall be immediately refilled and adequately “passivated” to prevent corrosion from oxidation, unless the system will contain steam. For steam containing systems (e.g. steam piping and equipment), “vapor phase” type corrosion inhibitors should be considered if the system is to be “laid up” more than 90-days. Civil Engineering’s IWT contractor will provide third party testing to insure refilled system is adequately passivated. All chemicals utilized to passivate the system shall be approved by Bioenvironmental Engineering.

7.8.2 IWT Systems

Blended soft water systems shall be utilized to provide “make-up” water for all steam/hot water and chilled water systems. Soft water for blended make-up shall be provided by dedicated water softener equipment. Acid softening systems shall not be utilized. Water softening equipment shall provide continuous soft water supply during system regeneration and designed to handle periods of increased demand caused by seasonal elevated evaporation rates.

Softener backwash piping shall be routed to a sanitary drain capable of handling increased flow during softener “regeneration” cycle.

7.8.3 IWT Chemicals

All chemicals use to passivate metallic surfaces, scavenge dissolved oxygen or inhibit bacteria /algae, shall be specified by the IWT expert after consultation with Civil Engineering’s IWT contractor. Chemically treated systems shall be isolated from domestic water supplies by an Ohio EPA approved backflow prevention device. Discharge points for treated water shall be approved by Civil Engineering’s Environmental Branch.

7.8.4 Filters and Chemical Feeders

All “open” loop cooling water systems shall utilize “side-stream” type media filters to remove system solids (e.g. scale, oxides, entrained solids). All “closed” loop hot and chilled water systems shall utilize “by-pass” bag filters for system solids removal (e.g. mill scale, chemical sludge, entrained solids). Both filtering systems shall have “shot” feeders for the addition of IWT chemicals to the system. Filter backwash piping shall be routed to a sanitary drain capable of handling increased flow from filter “backwash”

cycles. The IWT expert shall insure adequate sample and injection points are installed on system piping for the IWT equipment.

7.8.5 Domestic Water Softeners

All water softening systems shall be provided with a water meter to initiate softener regeneration, based on water flow through the softener. Softener regeneration based on time systems such as every 12 days, etc. shall not be allowed. Sodium zeolite softening systems and other systems that result in near zero treated water hardness shall be provided with a hard water blending valve, sized to provide a finished water with a hardness of approximately 100 ppm. Where special equipment requires a near zero hardness a separate water feed line to that equipment shall be provided prior to the blending of hard water. Sizing of the softening system shall be based on a combination of fixture unit counts, expected water usage, and other water usage factors to insure that the softener system is sized correctly. In general, water quality parameters for all potable water at WPAFB are as follows: Hardness 400 ppm; Alkalinity 300 ppm; TDS 490 ppm. Designers shall be responsible for verifying these numbers and conducting any additional analysis for proper sizing of softening systems.

8.0 FIRE PROTECTION

8.1 General

Designs shall be in conformance with the most stringent requirements among the latest editions of UFC 3-600-01, AFI's, IBC, NFPA, and items listed below. Appendices to these standards shall be considered a part of the standard. Advisory portions of the standard shall be considered mandatory as if the word "shall" has been substituted for the word "should". Any reference to the "Authority Having Jurisdiction" (AHJ) shall be interpreted to mean the Base Civil Engineering, usually delegated to the Base Fire Protection Engineer or the Base Fire Chief.

8.2 Fire Alarm Systems

8.2.1 Qualifications of the designer

Specification section 28 31 64.00 10 (13851A), paragraph 1.3.7.1 shall be changed to read:

- “A. Engineer having a Bachelor of Science or Master of Science degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of five (5) years' work experience in fire protection engineering.
- B. A Registered Professional Engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES).
- C. A registered P.E. in related engineering discipline with a minimum of five (5) years' experience, dedicated to fire protection engineering that can be verified with documentation..
- D. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current certification held.” Level III Certification minimum IAW NFPA72 (UFC 3-600-1 paragraph 5-1).

8.2.2 System Requirements

All buildings shall be equipped with a UL listed, local fire alarm and detection system that meets the requirements of NFPA 101, NFPA 70 and NFPA 72, latest editions. All buildings must be equipped with an addressable proprietary signaling system that transmits alarm, supervisory and trouble signals to the Base Fire Department. The system shall be an addressable type system capable of monitoring all points and provide emergency voice message capability. The system must meet the requirements of NFPA 72 and the following:

- 8.2.2.1 Fire alarm system control units shall use normally closed contacts for transmission of trouble and supervisory signals to the Base Fire Department.
- 8.2.2.2 Fire alarm system control units shall use normally open contacts for transmission of alarm signals to the Base Fire Department.
- 8.2.2.3 Fire alarm system control units shall be equipped for alarm verification if smoke detectors are installed in the building.
- 8.2.2.4 Wiring within cabinets, enclosures, boxes, junction boxes, and fittings:
- Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Conductors that are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make connections with approved pressure type terminal blocks, that are securely mounted. The use of wire nuts or similar devices shall be prohibited.
- 8.2.2.5 New fire alarm systems shall be designed and sized to serve the entire building. Multiple alarm panels within the building are not acceptable.
- 8.2.2.6 Where new systems in existing facilities are installed in phases, the Designer of Record shall ensure that the all portions of the building are notified and that the during and at the end of each phase, the Fire Alarm system (s) function as a single system
- 8.2.2.7 Provide a 12 ga., locking metal cabinet 37" tall x 5.5" wide x 4.25" deep, 18 ga. Steel construction, continuous stainless steel hinge, color red, power coat texture, 1" white indelible lettering stating fire alarm documents. Key cabinet the same as the fire alarm control panel. Install the cabinet adjacent to the fire alarm control panel or an area acceptable to the AHJ.
- 8.2.2.8 For all new construction and major renovations, provide a KNOX box system connected to the fire alarm panel. Provide the following note on the contract drawings: "Knox Box order forms are available through the Fire Prevention Section, 257-4075. Provide a note for the contractor to coordinate the keying the Knox Box through the Fire Prevention Section. Knox Boxes will be installed at a height between 48-60 inches.
- 8.2.2.9 A note shall be included in the contract documents that reads as follows: "The design and installation of the system control unit shall meet the requirements of NFPA 72, except as modified by these specifications or the contract drawings. Any conflicts between the drawings and specifications, and NFPA 72 shall be brought to the attention of the Base Fire Protection Engineer and/or Base Fire Chief for resolution. In all cases the most stringent requirement shall apply."

- 8.2.2.10 Evacuation Signal shall be a temporal pattern for new systems. When expanding or modifying an existing systems, signals shall match that of the existing system.
- 8.2.2.11 For new buildings, major renovations, and whenever a fire alarm system is replaced, the new FAS shall be voice evacuation type utilizing speaker type notification appliances in lieu of vibrating horns. See Section 8.6 Mass Notification for additional information.
- 8.2.3 All initiating devices shall have a label affixed permanently to the device identifying the address it has been assigned in the fire alarm control panel.

8.3 Installation Requirements

8.3.1 Qualifications of the Installer of fire alarm systems

Specification section 13851A, paragraph 1.3.7.2 shall be changed to read:

“Contractor shall provide:

- A. A NICET Level 3 or higher Fire Alarm Technician shall supervise the installation of the fire alarm system. NICET Level 2 or higher Fire Alarm Technician shall install and terminate fire alarm devices, cabinets and panels. An Electrician or NICET Level 1 Fire Alarm Technician shall be allowed to install conduit and wire for fire alarm systems. Fire alarm certification by the state of Ohio does not meet the minimum requirement.”

8.4 Automatic Sprinkler Protection

8.4.1 Design Criteria

Complete automatic sprinkler protection must be provided in all new or renovated DOD facilities. All new or renovated sprinkler systems must be designed and installed in accordance with the minimum requirements of NFPA No. 13, latest edition, except that the design density, design area, hose stream allowance and duration of supply requirements must be in accordance with the UFC 3-600-01. All advisory portions of the standard shall be considered mandatory. Additional design requirements include the following:

- 8.4.1.1 All wet-pipe sprinkler systems must be provided with a listed alarm check valve connected to a fire alarm panel and associated trim piping. All wet-pipe sprinkler systems must be provided with a listed riser check valve and flow switch assembly that is connected to the facility fire alarm system. Additional flow switches and accompanying supervised valves location shall be per NFPA, UFC, and IBC at a minimum. The additional flow switches and tamper switches shall

provide annunciation on a per floor/per building wing level, high hazard areas, and mission essential/critical areas. The use of an alarm check valve and pressure switch is prohibited unless required by the suppression system being installed.

8.4.1.2 All sprinkler systems must be equipped with a “Storz” type fire department connection for a five inch (5”) large diameter hose. Use a Storz 30-degree downward angle fitting. 24 inch minimum, 36” maximum clearance from the ground to the bottom of the connection. One connection may feed multiple sprinkler systems.

8.4.1.3 Sprinkler systems protecting more than 139 m² (1,500 sq ft) must be designed using hydraulic calculations. Calculations must follow the format of NFPA 13.

8.4.1.4 The A/E/Contractor shall be responsible to perform water flow tests for hydraulically designed systems. Schedule flow test with John Heckart, 88 CEG/CENMP, 904-1071.

8.4.1.5 Classify occupancies in accordance with UFC 3-600-01.

8.4.1.6 All sprinkler control valves shall be electrically supervised by the fire alarm control panel.

8.4.1.7 All sprinkler systems shall be equipped with a backflow prevention device of the type required for the given conditions in accordance with all NFPA and UFC requirements. As a minimum, a reduced pressure principle type device is required for aqueous film forming foam (AFFF) systems, and a double check valve type device is required for all other systems. The device shall be installed within 36 inches from where the fire service enters the facility. Where a fire pump is required, locate the backflow preventer as stated here rather than on the discharge side of the pump as suggested by UFC 3-600-01, but carefully size and design the backflow preventer to minimize the potential for cavitation at the pump. All backflow preventers shall be electrically supervised by the fire alarm control panel.

8.4.1.8 Existing PIV’s serving major renovation projects shall be electrically supervised by the fire alarm control panel. Provide new electrically supervised PIV’s on all new construction projects.

8.4.1.8.1 All wiring going to the electronic tamper switch that supervises the PIV will be in rigid conduit a minimum of one foot below the ground surface extending one foot above, and will be securely fastened to the PIV.

8.4.1.9 The use of pre-action sprinkler systems is not permitted without written approval of the Base Fire Protection Engineer and/or the Base Fire Chief.

- 8.4.1.10 Facilities with multiple fire department connections (FDC) will be required to have an exterior visual strobe installed eight to ten feet above the FDC. The strobe will be programmed to only activate when the flow switch that is associated with sprinkler system's FDC sends an alarm signal to the fire alarm system.

8.4.2 Installation Criteria

A minimum clearance of one meter (three feet) shall be provided on all sides of fire protection sprinkler risers, valves, check valves and similar devices to facilitate maintenance. All such devices shall be located within 1.5 meter (five feet) above the finished floor. Check valves and other devices requiring regular maintenance shall not be located above drop ceilings (in finished areas).

Sprinkler systems shall be isolated from the domestic water supply by proper electrically supervised backflow/back-siphonage/back-pressure prevention devices.

8.4.3 Aqueous Film Forming Foam (AFFF)

The Natural Resources Management Office, Environmental Assets Section (88 CEG/CEIEA), shall be notified of all proposed aqueous film forming foam (AFFF) systems. Discharge of AFFF into storm water systems is strictly prohibited, and discharge to sanitary sewers requires approval of the local wastewater treatment authority.

8.5 Fire Extinguishers

UL Listed fire extinguishers shall be provided with each fire extinguisher cabinet. A 10 lb ABC dry chemical fire extinguisher shall be the minimum size. A larger size shall be provided if required by NFPA 10. Cabinet size shall be determined by extinguisher size and provided as part of construction contracts. The Amerex model B456 10 lb. ABC is preferred.

Standard mounting height of cabinets shall be 48" aff to top of cabinet.

8.6 Mass Notification

- 8.6.1 Must be IAW UFC 4-021-01 (latest edition), (Design and O&M: Mass Notification Systems)
- 8.6.2 A Mass Notification System (MNS) is required in every new building and major renovation of existing buildings. MNS require that speakers be supervised for integrity. Provide Speaker notification appliances as part of the Fire Alarm System.
- 8.6.3 The MNS shall be tied into the notification appliance circuit of the FACP. Refer to UFC 4-021-01 for requirements for separate or combination FACP/MNS panels.

8.6.4 The MNS shall be capable of playing prerecorded messages as well as provide a microphone for live announcements.

8.6.5 MNS panels intended for use by the facility end user shall be located in accordance with UFC 4-021-01 and as mutually agreed to by the user, 88 CEG, and the Base Fire Department. The cabinet shall not be keyed the same as the FACP. Cabinets intended for use by the public shall not be locked.

8.6.6 Mass Notification Messages

8.6.6.1 **Bomb Threat:** “Attention Attention a bomb threat alert has been issued for this building, all personnel are to evacuate immediately using the nearest exit, further instructions will be issued outside the building by emergency response teams.”

8.6.6.2 **Terrorist Alert:** “May I have your attention please. A terrorist threat has been received effective immediately we are operating secure and lock down procedures, all personnel should remain calm and stay where you are and await further instructions.”

8.6.6.3 **Take Shelter:** “Attention Attention all personnel shelter in place.”

8.6.6.4 **Weather Alert:** “The national weather service has issued a weather alert for this area. Further information will be broadcast as it becomes available.”

8.6.6.5 **All Clear:** “May I have your attention please. All clear; the emergency has ended.”

8.6.6.6 **Audio Test:** “This is an audio system test. This is an audio system test.”

8.6.6.7 Messages will run continuous for 10 minutes once activated and will end automatically after the designated time. The system will need to allow messages to be ended manually.

8.6.6.8 It is recognized that a particular facility may have the need for unique Mass Notifications (i.e. chemical spills etc.). In the event such unique messages are necessary, they are to be reviewed by the 88 CEG representative and the Base Fire Department and 88 ABW/ATO for their concurrence.

8.7 Fire/Smoke Rated Walls

Identify all fire rated walls that have a fire rating of 1-hour or greater by labeling the wall with the following: “X (X would be the rating of the wall) Fire Rated Wall”. Identify Smoke Barriers with the following: “Smoke Barrier”. Fire/Smoke Rated Walls shall be labeled every 20’ at minimum.

- Do not mix firestopping sealant colors on a project. Use a consistent sealant color for all firestop penetrations on a given project. Whenever possible, match color of existing firestopping sealant in a given building.
- Label all penetrations, joints, and gaps with the firestopping system used to maintain the wall rating.
- Identify penetration firestopping with preprinted labels. Attach labels permanently to surfaces adjacent to and within 6" of edge of the firestop systems, so that labels will be visible to anyone seeking to remove penetrating items or firetop systems. Use self-adhering type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed, and in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
 - a) "Warning – Through-Penetration Firestop System – Do Not Disturb. Notify Building Management of Any Damage"
 - b) Contractor's name, address, and phone number
 - c) Through-penetration firestop system designation of applicable testing and inspecting agency
 - d) Wall rating
 - e) Date of installation
 - f) Through-penetration firestop system manufacturer's name
 - g) Installer's name

9.0 ELECTRICAL

9.1 General

9.1.1 Electrical work includes, but is not limited to, the design of the following systems: Primary Electrical Distribution Systems, Secondary Electrical Distribution Systems, Lighting Systems, Lightning Protection Systems, and Grounding Systems.

9.1.2 Designs shall be in conformance with the applicable portions of the latest editions of the following codes and publications:

- UFC 3-501-01; Electrical Engineering
- UFC 3-520-01; Design: Interior Electric Systems
- UFC 3-530-01; Interior and Exterior Lighting Systems and Controls (references IES Lighting Reference Guide)
- UFC 3-535-01; Visual Air Navigation Facilities
- UFC 3-550-01; Exterior Electrical Power Distribution
- UFC 3-570-02A; Cathodic Protection
- UFC 3-570-02N; Electrical Engineering Cathodic Protection
- UFC 3-575-01; Lightning and Static Electricity Protection Systems
- Applicable Air Force standards (AFI's, AFM's, ETL's, etc.)
- DOD 6055.09-STD; DOD Ammunition and Explosives Safety Standard
- AFI 32-1065; Grounding Systems
- AFMAN 32-1076; Design Standards for Visual Air Navigation Facilities
- AFPAM 32-1192; Energy Efficient Motors and Adjustable Speed Drives
- AFMAN 90-201; Explosives Safety Standards
- 10 CFR 435, Performance Standards for New Commercial & Multi-Family High Rise Residential Buildings. This regulation was enacted to comply with Executive Order 12902 of 1994 and the US Energy Policy Act of 1992, Public Law 102-486. This standard is mandatory for new Federal facilities.
- ANSI C2; National Electrical Safety Code
- Army Technical Manual TM 5-811-3; Electrical Design Lighting and Static Electricity Protection
- Army Technical Manual TM 5-811-6; Electric Power Plant Supply
- IEEE, ANSI, NEMA, and UL Standards; all that apply
- NFPA; all that apply
- NFPA-70; National Electrical Code
- NFPA 780; Standard for the Installation of Lightning Protection Systems

9.2 Drawings, Specifications, and Design Requirements

9.2.1 Electrical drawings shall provide all necessary construction details for proper installation and accurate bidding. Electrical drawings shall include, but not be limited to the following:

- One Line Diagrams showing all switchgear, switchboards, panelboards, enclosed switches, enclosed breakers, transformers, generators, UPS systems, switches, meters, surge arresters, motors, motor controllers, reactors, capacitors, contactors, feeder conduit sizes, feeder conductor sizes, breaker ratings, fuse ratings, and AIC ratings (Riser Diagrams may also be included, but are not a substitute). Location (Room number) shall be shown for all electrical equipment.
- Control Diagrams for all motors
- Panelboard Schedules for all new and revised panelboards
- Lighting Schedules listing the salient features of each new luminaire
- New and removed items clearly located and delineated
- Installation and removals shall be shown on separate plan views and/or section views
- Legend, with all symbols used in the design
- List of all abbreviations used
- Wiring Details, showing phase, neutral, and home run conductors for each circuit
- Hazardous Areas (i.e., Class, Division, Group per NEC) shall be clearly identified and labeled on the drawings
- Power rating of all motors shall be shown
- Special grounding and isolated grounding details

9.2.2 Electrical specifications shall be based on UFGS guide specifications and shall detail requirements for all electrical materials that will be used during the construction of the designed project.

9.2.3 Design requirements shall include the following:

- The electrical engineer responsible for the design shall visit the site, and verify existing conditions.
- The electrical designer shall perform load analysis which shall determine the size of the new load and if the existing electrical distribution system is capable of supporting the new load. If the existing electrical distribution system is not capable of supporting the new load, electrical designer shall design required changes to properly support the new electrical load.
- The electrical designer shall perform short circuit analysis to determine the short circuit rating required for all overcurrent protective devices.
- The electrical designer shall perform a coordination study to ensure that the new distribution system is coordinated and will coordinate with the existing distribution system.
- The electrical designer shall perform life cycle cost analysis on major components, and any components requested by the government, to achieve the lowest total system cost.
- The electrical designer shall perform voltage drop calculations on all services, feeders, and on the worst case branch circuits for each panelboard and switchboard.

- The electrical designer shall perform lighting calculations for each room and site. Calculations shall be based upon maintained foot-candle intensity and IESNA recommendations.

9.3 Medium Voltage Systems

- 9.3.1 Most medium voltage systems at WPAFB have been privatized, and are owned and operated by the Dayton Power and Light Company (DP&L). They typically own and operate all medium-voltage facilities up to and including the transformer stepping primary voltage (12470 volt or 6900 volt) down to secondary voltage (480/277 volt, 240 volt, or 208/120 volt). Secondary voltage conductors and all downstream devices belong to the Government.
- 9.3.2 Any work that may require new service or a change in DP&L's electric service shall be coordinated with the Electric Utility Privatization POC.
- 9.3.3 The following requirements apply to Government medium-voltage systems, such as those operated by AFRL.
- 9.3.3.1 New pad-mounted switches shall be air-insulated, unless permitted otherwise by the Government.
- 9.3.3.2 New 15kV cables shall be type TR-XLP or EPR, have 133 percent insulation system, and shall have copper conductors. New medium voltage transformer feeders shall be either #1/0 or #4/0 in size, unless a larger cable size is required to support the load. New 15kV cables shall be installed in concrete encased ducts (3" cover minimum) except for in housing areas. New ducts shall be sloped to drain to manholes. New 15kV feeders shall include a #1/0 600-volt neutral copper conductor.
- 9.3.3.3 Minimum inside manhole dimensions shall be 2.14 m by 2.14 m by 2 m (7' by 7' by 6'6" high). New manholes shall include pulling irons opposite all ducts, and cable rack supports on all four manhole walls. All new cables in manholes shall be routed the long way around the manhole to provide slack for future splices. Provide racks as required to properly rack all new cables in manholes.
- 9.3.3.4 Handholes and manholes shall have steel H-20 rated lids.
- 9.3.3.5 Pad mount transformers shall be dead front, and shall be located a minimum of 3.05 m (10') away from any facility.
- 9.3.3.6 New medium voltage transformers shall include fuses and lightning arresters. New transformers shall be sized with a minimum of 25% spare capacity for future load. New transformers shall have copper windings.

- 9.3.3.7 New concrete pads for external pad mounted transformers, switches, and other electrical equipment shall have thickened edges. Interior floor mounted transformers, switches, and other electrical equipment shall have raised 4" concrete pad for housekeeping purposes.
- 9.3.3.8 Ducts from new 15kV switches shall go to a manhole before going to a transformer or another 15kV switch.

9.4 Low Voltage Systems

- 9.4.1 New conductors shall be copper. New conductors installed below grade shall have type XHHW insulation. Maximum conductor size shall be 500 kcmil. Conductors shall be paralleled as required to comply with this requirement. MC cable shall not be used in lieu of conduit.
- 9.4.2 Use of stranded conductors for #10 and smaller are allowed. All terminations of stranded wire shall be by compression type connectors. E.g. wirenuts, crimps, wire binding screw, flag lugs and terminals with pressure plates. No stranded wire shall be terminated directly under a screw head without having a compression terminal applied, such as a ring or fork terminal.
- 9.4.3 208Y/120V Volt or 120/240 Volt Branch Circuit Panelboards shall have 200 percent rated neutral bus.
- 9.4.4 Do not use shared neutrals for any circuits. Neutrals that are part of a panelboard feeder that feeds nonlinear loads shall be oversized to a minimum of one trade size larger than the phase conductors.
- 9.4.5 Do not use class H fuses.
- 9.4.6 Panelboards, switchboards and switchgear shall have copper bus. New panelboards and switchboards shall have a minimum of 20 percent spare breakers or space for future breakers. New panelboards and switchboards shall have 20-25 percent spare ampacity for future growth. New panelboards and switchboards shall be balanced to the maximum extent possible, so no phase shall be less than 80 percent or more than 120 percent of the average load. Switchboards and switchgear shall have raised 4" concrete pad for housekeeping purposes.
- 9.4.7 Panelboards not in sight of the feeder over current protection shall have a main circuit breaker.
- 9.4.8 Panelboards with more than 12 spaces shall have bolt on style circuit breakers.
- 9.4.9 In a building with more than 1 low voltage transformer, one-half of the low voltage transformers shall be phase shifted by 30 degrees from the other low voltage transformers.

Where possible, harmonic mitigating transformers with dual secondary windings phase shifted 30 degrees relative to each other shall be utilized to further enhance harmonic cancellation. In buildings with 1 low voltage transformer, the low voltage transformer shall be a harmonic mitigation type transformer to eliminate the third harmonic. All new transformers shall be sized with a minimum of 25% spare capacity for future load. New transformers shall have copper windings. New transformers that supply computer loads shall have an electrostatic shield. Single phase transformers may not be banked into three phase transformer banks.

- 9.4.10 Raceways inside facilities shall normally be concealed. All raceways in office areas, conference rooms, and similar type areas shall be concealed. EMT raceway shall be connected to enclosures and other raceways with malleable steel connectors, either compression or set screw type. Die-cast fittings shall not be used for EMT raceways.
- 9.4.11 Feeders shall be sized for a maximum 2 percent voltage drop. Branch circuits shall be sized for a maximum 3 percent voltage drop.
- 9.4.12 Each conduit shall include a copper equipment grounding conductor sized in accordance with the NEC. Equipment grounding conductors shall be insulated.
- 9.4.13 Ducts installed below grade shall be 2" minimum size unless concrete encased. Ducts installed under pavements shall be concrete encased.
- 9.4.14 Autotransformers may not be used.
- 9.4.15 Receptacles and other wiring devices shall be wired with the screw terminal connections, not the push in connections.
- 9.4.16 Engraved nameplates shall be provided for each piece of electrical equipment. Nameplates shall indicate the Name of the Device or Equipment, Voltage, and phase, Upstream device (Fed from), Load served, and Installation Date. Where necessary include "Via XFMR TX".
- 9.4.17 Panelboards shall have hinged front covers.
- 9.4.18 Exterior bus duct is prohibited.

9.5 Arc Flash Labels

Arc flash labels shall be on all electrical equipment items, to include but not limited to, panelboards, motor controllers, MCC's, switchgear, switchboards, enclosed switches and circuit breakers, industrial control panels, and meter socket enclosures that are in other than dwelling occupancies. Arc flash labels shall include all of the following information:

- Available incident energy and corresponding working distance
- Minimum arc rating of clothing

- Highest Hazard/Risk Category (HRC) for the equipment
- Nominal system voltage
- Arc flash boundary
- Upstream power source

9.6 Motors

- 9.6.1 Provide High Efficiency Motors in accordance with Energy Standard 10 CFR 435 to achieve maximum energy conservation.
- 9.6.2 Provide power factor correction for all motors 7.5 kW (10 HP) and larger. Power factor correction shall be to 95 percent at rated load for the motor.
- 9.6.3 Provide soft start or reduced voltage starting for all motors 15 kW (20 HP) and larger.
- 9.6.4 New motor controllers shall include hand-off-auto switch. New pilot lights shall be a LED type with a replaceable lamp unit.
- 9.6.5 In HVAC and Plumbing designs Variable Frequency Drives (VFD's) shall be used in applications where partial loading occurs. VFD's controlling motors of 20HP or greater and include a 5 percent line reactor; or a low pass harmonic filter designed to reduce the total harmonic current to 12 percent or less of full load rating throughout the VFD operating capability. Low pass filters shall have the capacitors switched out when the motor is not operating. Low pass filters shall also not cause resonant conditions under any possible load conditions within the facility. VFD rated motor cable shall be used for the circuits from the VFD to the motor.
- 9.6.6 Motors and controllers shall comply with the recommendations of AFPAM 32-1192 unless the requirements herein are more restrictive.
- 9.6.7 For a facility where more than one new VFD is installed, and at least 2 of the motors are 15 KW (20 HP) or larger, approximately one-half of the total new motor load shall be phase shifted by 30 degrees with respect to the other new motors to cancel most of the 5th and 7th harmonics. The phase shift shall be accomplished by the installation of a delta-wye isolation transformer(s).

9.7 Lighting

- 9.7.1 The preferred interior light source is a 265 mA 4-foot F28T8 or F25T8 lamp, color temperature of 4100K, with a low ballast factor electronic ballast ($0.71 < BF < 0.78$). 277 volt lighting is preferred.
- 9.7.2 Individually mounted luminaires shall be fed with 6 feet of 1/2" flexible metallic conduit. Ensure proper support per NEC.

9.7.3 Exterior light sources shall be LED type, except for recessed can luminaires that may have compact fluorescent lamps. Exterior LED lighting shall have a minimum 10 year manufacturer's warranty and a built-in Surge Protective Device (SPD). Provide a Transient Voltage Surge Suppression (TVSS) device for all circuits feeding exterior lighting systems.

9.7.4 Do not use F40T12 fluorescent lamps or low-pressure sodium lamps.

9.7.5 Do not use incandescent lighting unless approved by Electric Utility Privatization POC.

9.7.6 Light switches shall be equipped with occupancy sensors. The sensors shall be designed with the proper combination of automatic and manual lighting control to achieve maximum energy efficiency and conservation.

9.7.7 Unitary Lighting Control systems for programmable Automatic Shutdown and Time Schedule functions shall not be installed. Those functions shall be incorporated into the HVAC DDC system design plan. Refer to Lighting Control section 7.6.6.

9.7.7.1 Requirement does not include local occupancy sensing devices.

9.7.7.2 Does not include local time clocks where no DDC system is available.

9.7.8 Recessed and surface-mounted can light fixtures shall not be used as emergency light fixtures.

9.7.9 Stairwell Lighting

Only use wall mounted fluorescent luminaires. Wall mounted fluorescent light fixtures shall be installed not to exceed 10ft in height.

9.8 Energy Metering

9.8.1 All Base facilities are required to have an energy meter for each utility utility (electric, natural gas, steam, and water) in accordance with AFI 32-1061, Providing Utilities to US Air Force Installations. New energy meters shall be Schneider Electric Powerlogic 850 series or better, to be compatible with existing 88 CEG monitoring software. Natural Gas, water, and steam meters shall have a 0-5 VDC or 4-20 mA pulse output as specified by the PowerLogicPower Meter 800 I/O Module Tech Data Sheet. Required cabling will be run between the meter pulse generator and the PM800 I/O Module.

9.8.2 Each energy meter shall be connected to the Base Energy Management Center (EMC) in Building 30022 through a Powerlogic Ethernet Communication Card or Powerlogic Gateway. See section 10.13.5 for 88 CG outlet designation (UMS). Required Ethernet cabling shall be installed per 88 CG requirements between the metering device(s) and the facility network switch.

9.8.3 The Energy Meter, associated wiring, CT shorting blocks, PT disconnect or fuses, and Ethernet connectivity device shall be mounted within a separate metering compartment of the Main Distribution Panel, or in a remote cabinet separate from the MDP.

9.8.4 Energy Meters should be included on utility service entrances whenever and wherever practical, based upon the type of work included in the project as well as the size and scope. Advanced meters shall be installed on all utility systems renovations exceeding \$200K, new MILCONs, major renovations, Energy Conservation Investment Program (ECIP) projects, or Energy Savings Performance Contracts (ESPC) projects.

9.9 Generators

9.9.1 New generators shall have a minimum 3-day fuel supply.

9.9.2 New generators shall be installed at grade, or inside a facility. Concrete pads shall have thickened edges.

9.9.3 Catwalks shall be installed on all new generator fuel tanks to allow for fueling and taking fuel measurements on top of each tank.

9.9.4 Requirements of AFI 32-1062 must be incorporated into the design, including 4 pole ATS, and ATS bypass requirements.

9.9.5 Generators with sub-base tanks installed that will require a ladder for personnel to access the generator controls or perform regular maintenance shall have fixed stairs or catwalks with stairs installed.

9.9.6 Sub-base tank filling apparatus shall be gravity fed fill. Fill placement shall be no more than 3" below the lip of the lockable containment vessel surrounding the fuel fill.

9.9.7 Install only emergency electrical generators and any other stationary combustion engines that meet the application emissions standards and fuel requirements as outline in New Source Performance Standards 40 CFR 60, Subpart IIII (compression ignition) or Subpart JJJJ (spark ignition).

9.9.8 All electrical generators shall be equipped with a non-resettable hour meter.

9.10 Lightning Protection

Lightning protection air terminals and conductors shall be copper unless installed on an aluminum or steel surface.

9.11 Security Alarm Systems

Security alarms must be compatible with the Base Infrastructure and monitoring software.

10.0 **TELECOMMUNICATIONS**

10.1 **General**

Communications within this section refers to all telecommunications requirements and is not simply limited to telephone systems. **Telecommunications** covers any transmission, emission, or reception of signs, signals, writings, images, and sounds, or information of any nature by wire, radio, visual, optical or other electromagnetic systems. Similarly, **cabling** not only applies to only the cables themselves, but also includes a combination of all cables, wire, cords and connecting hardware. Installation of Communications Equipment Rooms (CER), entrance, backbone, and horizontal cabling should be in accordance with the latest editions of government and industry codes and standards, and this standard. Designs shall be in conformance with the applicable portions of the latest editions of UFC 3-580-01, ETL's, AFI's, IBC, NFPA, the National Electric Code (NEC), and American National Standards Institute/Telecommunications Industry Association/Electronics Industries Alliance (ANSI/TIA/EIA)-568 and -569. Telecommunications grounding will be done in accordance with TIA-EIA-607 and ANSI-J-STD-607-A-2002.

Items that need special wiring and/or interface equipment must be identified. Specifications for special equipment should be provided. This includes items such as alarms, elevator lines, paging systems, video teleconference equipment, weatherproof telephones, intrinsically safe telephones, building entry control systems, etc. Ref: TIA/EIA-568B.1 Section 4.1.

The Architect/Engineer (A/E) shall coordinate all designs supporting communications and information system requirements with the Base Civil Engineering, the using agency, and the Base Communications Systems Officer. The A/E shall include communications pre-wiring for buildings in all construction projects. Telecommunications design must be performed and stamped by a Registered Communications Distribution Designer (RCDD) for all projects. Before the RCDD stamps the design, it must be coordinated with and approved by the 88 CG Project Manager and Lead Engineer. In all new construction or major renovations, the telephone service will be changed to Voice Over Internet Protocol (VOIP), except in rare cases due to classified area rules. Coordinate with the 88 CG Project Manager for any exceptions.

A detailed work plan and design for all communications work to be done shall be included by at least the 65% design review.

10.2 **Communications Equipment Room (CER)**

A facility that has significant communications systems requirements and is greater than 929 square meters (10,000 square feet) in area must have a CER. Unoccupied and/or small facilities such as guardhouses, utility control buildings, and storage bunkers typically do not require a CER (if these small buildings require telephone and/or network connection they will require a cabinet or wall space (4 ft by 5 ft of space) to mount equipment, and conduit to this location from the nearest communications manhole). The CER serves as the entrance facility for all incoming communications ducts and service and as the location for communications and information

infrastructure such as the building Private Branch Exchange (PBX), Remote Switching Terminal (RST), Local Area Network (LAN) switches, and user unique systems, like the AFRL Research, Development, Testing, & Engineering (RDT&E) network. The CER shall be its own entity, readily accessible to maintenance personnel and not co-located within or have to be accessed through mechanical or electrical rooms.

10.2.1 CER Location

At least one primary CER shall be included on each respective floor level of the building and shall be vertically "stacked" directly over the one on the floor level below. If multiple CERs are required on the same floor and/or they cannot be stacked, they shall have 4- inch conduits run between the CER and the main CER for the facility. A minimum of two 4-inch conduits will be run to facilitate installation of the backbone copper and fiber cabling, one conduit shall have at least 3 three-cell interior rated MaxCell fabric innerducts installed for the fiber runs. Additional conduits shall be installed if either or both of the conduits are over 60% full to allow for future cable installation. Keep all conduit penetrations within the CERs within 2" of the walls. If structural or M/E/P designs do not allow for this and they extend out into the open floor area, then the size of the CER should be expanded to ensure safety aisles can be maintained without creating a safety hazard.

Quantity and placement of CERs shall be in accordance with the standard that horizontal distribution cable runs shall not exceed maximum allowable lengths (3 meters (10') from client wall-plate to the computer, 90 meters (295') from the faceplate to the CER, cable length allowed in the CER is 7 meters (23'). Therefore, the total length of a circuit must be no greater than 100 meters (328') in accordance with Electronic Industry Association/Telecommunication Industries Association (EIA/TIA) 568 and EIA/TIA-569 standards.

The CER should have 19-millimeter (0.75-inch) fire rated plywood backboards on all walls (unless otherwise specified by the 88 CG Project Manager), from no greater than 0.3 meter (1 foot) above the finished floor level to no less than 2.1 meters (7 feet) above the finished floor level. (NOTES: If fire-rated (fire-retardant) plywood is to be painted, the paint should not cover the fire-rating stamp until inspection by the authorized Government contract/project representative is complete (**the finished side shall be mounted outward, so the wood may need to be inspected and approved prior to mounting**). To reduce warping, fire-rated (fire-retardant) plywood shall be kiln-dried and shall not exceed moisture content of 15 %.)

Appropriately sized basket/flex cable tray system shall be installed around the perimeter of the room and across the middle (centered over the cabinets/racks) above the height of the cabinets/racks. The cable tray shall be grounded per TIA and BICSI standards.

See figure 1 for standard CER layout (9'X12' is normal minimum size, if room is larger or smaller, then location of racks and cable basket/flex tray shall be shifted in coordination with the 88 CG PM). This size of 9' X '12' was chosen to allow for minimum spacing around and between racks. The 9' width allows for 36" from one wall to rear of

communications equipment in the racks, 30” for approximate dept of communications equipment in the racks (some may actually be deeper), then 36” clearance in the front of the racks and 6” for the 110 blocks, ground bars, etc. on the wall in the front of the racks. The 12’ length allows for three racks with vertical cable management (approximately 6.5’ and room to install a rack, separated by at least 24” for classified equipment, or installation of additional racks as required. A jack for a wall-mounted phone shall be located in the CER, across from the front of the equipment racks. Unless absolutely necessary, other building system equipment (such as fire alarm panels, access control equipment, security system equipment etc.) shall not be located in the CER. However, when other building systems are placed on the walls or in the racks in a CER, then the minimum size of the CER needs to be increased to allow for proper clearances.

Provide a 0.91-meter wide by 2.03-meter high (36-inch wide by 80-inch high) single-leaf door hinged to open outward and fitted with a 369 cored lock to control access to the room. Install tamper resistant type door hinges, or mount hinges in a way to prevent the hinge pins from easily being removed. In new or renovated buildings, the Comm Room lock should be dual-cored with a 369 core and a building Real Property Building Manager (RPBM) master key core.

Entry CER Sizing Table 1

Building Usable Area Square Meters (Square Feet)	CER Size Square Meters (Square Feet)	Number of 102-millimeter (4-inch) Entrance Conduits (Min)
<1858 (<20,000)	37 (400)*	3
1858 to 9290 (20,000 to 100,000)	46 (500)	4
9290 to 18580 (100,000-200,00)	84 (900)	5
Every Add 18580 (200,000)	+56 (+600)	+1

NOTE: Not less than 2:1 ratio length to width

* Adjustments may be made for small buildings, minimum size 10 Sq Meters (110 Sq Ft)
Recommended minimum size is 9’X12’ to allow for maximum use of space within the CER.

Non-communications hardware or equipment panels (e.g. electrical/lighting control system, physical access control system, fire alarm panels, or other facility control systems) should not be installed within the CER without prior coordination and approval from the 88 CG Project Manager.

10.2.2 Vertical CER Connectivity

Enough sleeves shall be installed to interconnect a CER to the CER on the floor level(s) directly above it, with at least one empty fire rated pathway between floors after all facility pre-wiring is installed. A minimum of one 4-inch conduit to/from the primary CER shall be used for fiber-optic cable and one for copper cables. All conduit and other penetrations

through fire-rated walls, ceilings, and floors must use fire rated pathways in accordance with the NEC.

Typical Comm. Room layout (overhead view)

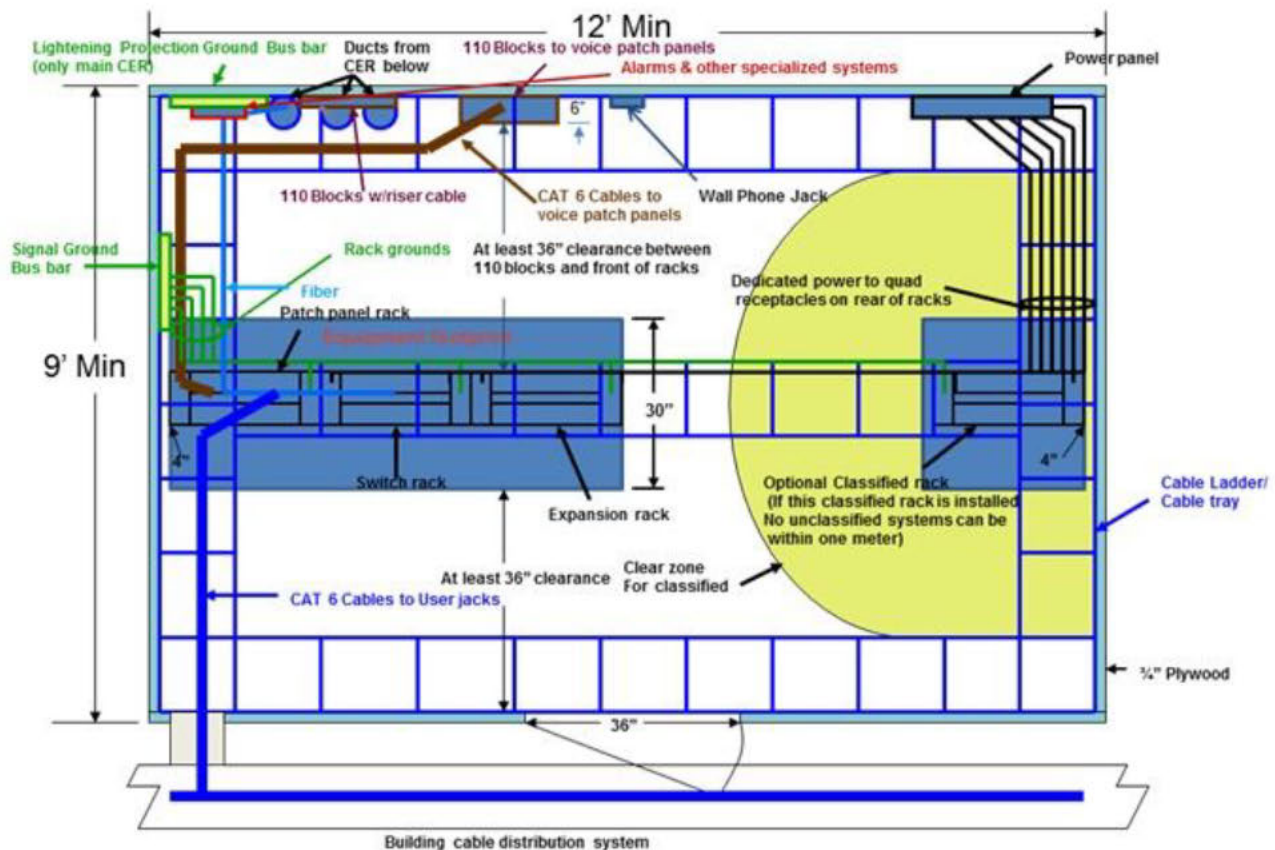


Figure 1

10.2.3 Communications Equipment Room (CER)

If more than one CER is required on a floor and/or it can't be stacked with the CER below, the CER shall be connected to the main CER for the building with a minimum of two 4-inch conduits, one for backbone copper and one for backbone fiber cabling. Additional conduits are required if any conduit is over 50% filled. A minimum of one 4-inch conduit to/from the primary CER shall have enough interior rated MaxCell inner duct placed within the conduit for fiber-optic cable to completely fill it (usually three to four 3-cell units). These conduits must be labelled according to TIA standards.

10.2.4 Horizontal Cable Connectivity

An overhead or in-ceiling delivery system shall be used and a minimum of four, four (4) inch fire rated pathways shall be used to route cables into the ceiling spaces to the work areas from the CER or through intermediate walls. Overhead cable trays and all through-wall pathways shall be used to route voice and data cables from the CER that are properly

sized for the number of cables to be installed and to permit at least 40% future cable expansion within the building.

10.2.5 CER Power Requirements

Provide a minimum of two dedicated non-switched 20-amp, 120-VAC outlets, each on a separate branch circuit for each rack that will hold communications equipment (see figure 2). Increase these minimum requirements as necessary to meet equipment loads (check with the communications project manager to verify the power requirements and type of connectors required to support the equipment to be installed. Much of the newer communications equipment requires 30 or 20 Amp 220Vs. Install the receptacles between 6-12" from the floor). These two outlets should be mounted to either side and at the rear of the network equipment racks and be placed so they won't interfere with installation of equipment in the rack. If more than one rack is installed each rack should have two power outlets on separate branch circuits installed on it. Support the equipment with UPS units where continuous equipment operation is required or where economically justified. If facility has emergency generators, ensure the outlets that feed the comm. racks are fed from power that is supported by the generator. Provide additional 120-VAC convenience outlets on the walls around the CER for maintenance and housekeeping (these do not need to be generator fed). In addition, the CER shall have a minimum of one 110V, 20-Amp circuit for security equipment power (this shall be fed from emergency power if available). Back-up all electrical loads in the CER with standby generator power if required by the Base Communications System Officer (BCSO).

WPAFB is moving to Voice Over Internet Protocol (VOIP) telephone support, the network switching equipment is being upgraded to Power Over Ethernet (POE) support to power the telephone instruments. This will require larger/different power in the CERs to accommodate the larger UPS and power supplies in the switching equipment. This will result in all but the smallest user count CERs requiring L6-20 and/or L6-30 power connections be installed. The 88 CG Project Manager working with the assigned network engineer will identify these requirements as the design of the facility progresses. As a basic rule of thumb in small CERs (less than 90 users) standard dedicated 20 amp outlets should work. In CERs with more than 90 users we will want two L6-20, and two L6-30 outlets. These will be refined as the design is refined and the user requirements are finalized.

Note: Power outlet placement on the back of a relay rack shall not interfere with the placement of hardware within the rack or use of the mounting rail space.

Comm. Room Rack Power Layout

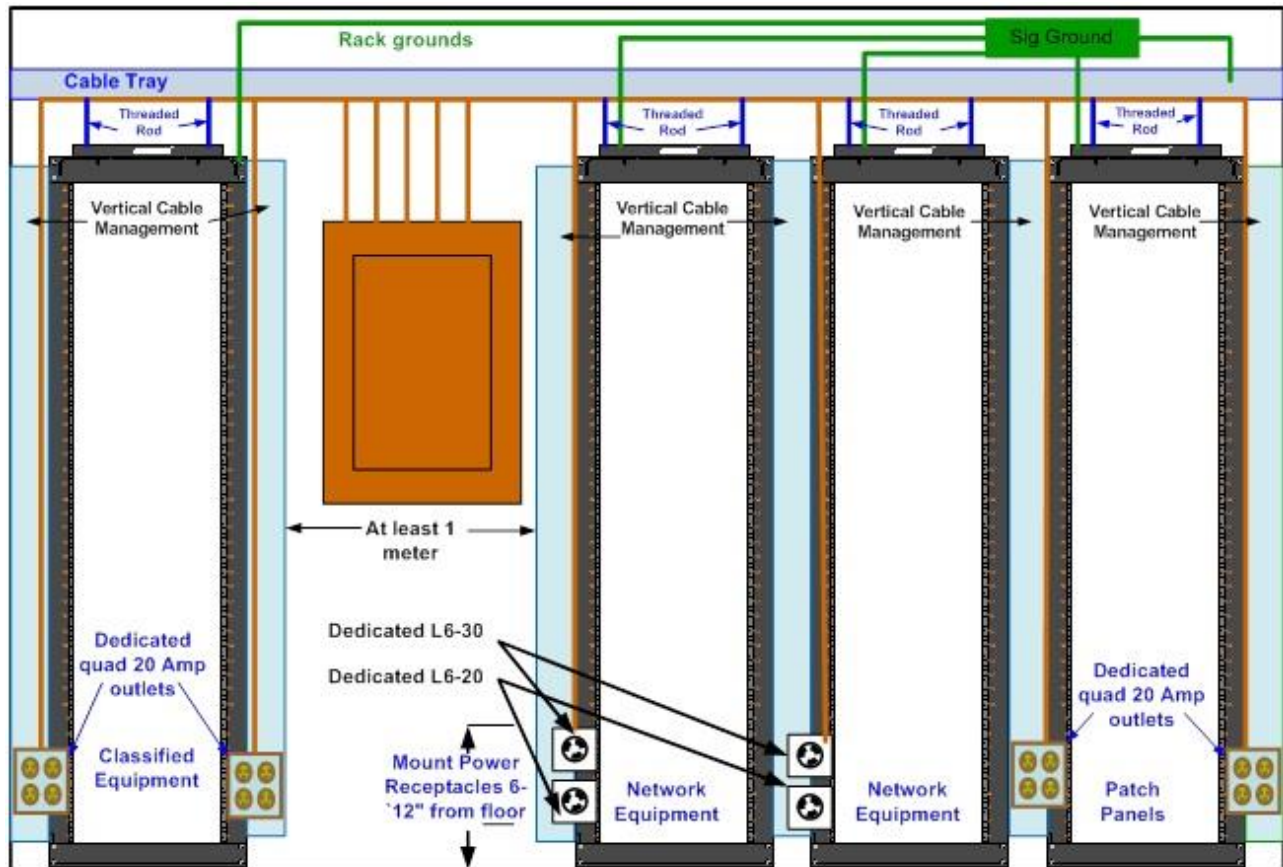


Figure 2

10.2.6 CER Grounding

Ground connections in the CER must meet National Fire Protection Association (NFPA) 70, NEC, and TIA/EIA/BICSI standards. In the main CER where cables enter the building a lightning protection ground bus bar must be provided so that the outside plant cable shield and the surge protection blocks can be connected to it. Provide a lightning protection ground bus bar (minimum of 100 millimeters high by 509 millimeters long [4-inches high by 12-inches long]) installed (2 feet) above the floor near where the cables enter the main CER from the outside plant. A separate signal ground bus bar must be installed in all CERs to provide a single-point ground for all communications/electronics equipment within the CER. The signal ground must not be connected to the lightning protection ground within the building. See typical grounding diagram (Figure 4). Provide a signal ground bus bar with minimum dimensions of 6 mm (0.25 in) thick x 100 mm (4 in) height and variable width to meet the application requirements and with consideration of future growth. The signal ground shall be installed 2.1 meters (7 feet) above the floor on a wall nearest the equipment racks within the CER. Both bus bars should be the type that uses two-hole grounding lugs. All telecommunications grounding busbars will meet BICSI and J-STD-607 requirements for network systems grounding applications and must be sized to allow for 50% additional

connections after all racks and cable trays have been properly grounded. A National Electrical Manufacturers Association (NEMA) hole pattern is not acceptable.” The ground riser from the ground plate to the single main electrical service entrance ground must be sized according to J-STD-607-A (see table 2 below) and directly connected to the ground plate with no taps.

The grounding electrode system for sites that are critical in nature (e.g., public safety facilities, military installations, data centers, web hosting facilities, and central offices) shall be designed to have a resistance of 10 ohms or less, preferably 5 ohms or less. The grounding electrode system design must take into account seasonal fluctuations such as moisture and temperature. If 5 ohms cannot be achieved then the 88 CG Project Manager must be notified and must approve a deviation from 5 ohms.

All connections of wire-to-wire and/or wire-to-ground rod must be exothermic-welded. All lugs used on the ground wires must be the non-reversible type (crimp on or welded). Extend the proper size copper ground wires (according to table 2) from the CER ground plate to all other CERs within the building and connect to a signal ground bus bar in those CERs. Bond each signal ground bus bar to non-current-carrying metal building parts, such as metal framing, within the CER as required by the NEC.

Sizing of ground cables from main ground point to each bus bar and between bus bars	
Cable length in m (ft)	Cable Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
Greater than 20 (66)	3/0

Table 2

- 10.2.6.1 Each grounding and bonding conductor shall be labeled. Labels shall be located on conductors as close as practicable to their point of termination in a readable position. Labels shall be nonmetallic, plastic or plastic coated so they don't deteriorate and become illegible over time (cannot be handwritten), and include the information in figure 3 below.

**IF THIS CONNECTOR OR CABLE IS
LOOSE OR MUST BE REMOVED,
PLEASE CALL THE 88 CG HELP
DESK AT 656-2666**

Figure 3

10.2.7 CER Environmental Requirements

Provide heating, cooling, and fresh air appropriate for the equipment housed. CER's that have electronic equipment installed require year round cooling.

Communications Equipment Room (CER) Heating Load

1. Small CER for less than 90 users, BTUs/hr = 3,500
2. Large satellite CER for 90 to 300 users or with main building switch, BTUs/hr = 22,000
3. Intermediate size CER 90-200 users, BTUs/hr = 12,000
4. Information Transfer Node (ITN) (these are critical nodes and we will have to specifically identify any facility that will get another one of these), BTUs/hr = 27,000

Note: Heat load figures above assume CER containing standard communications equipment. If other building systems equipment is located in the CER, heat loads must be adjusted accordingly (reference para. 8.2.1 above).

The temperatures range of our main switch equipment is 50 – 95 degrees Fahrenheit internal temperature

CERs need to be kept below 80 degrees and have sufficient air flow to prevent heat build-ups.

NOTE: If a remote telephone switch is located in the CER, the room temperature must not exceed 75 degrees.

10.2.8 CER Floor and ceiling coverings

Floors should be treated/sealed concrete or static resistant tile. Carpet or carpet tiles will not be an acceptable floor covering within any CER. Floors, walls, and ceilings must be painted/sealed to reduce dust. Finishes must be light in color to enhance room lighting.

Ceiling areas should be open to structure above. If the true ceilings are very high, then a drop ceiling may be considered for use (this must be coordinated with the 88 CG project manager during design). When drop ceilings are used they need to be high enough to allow cable trays to be mounted below them with at least 12" clearance above the cable tray to allow access to add/remove cables.

10.2.9 Building Entrance Terminals (BET) (Copper)

Provide gas protector modules in the Building Entrance CER to protect the inside plant wiring and equipment from voltage surges. Protected 110 terminals (or where distribution frames are used, the proper protection modules for that type frame) shall be used for copper cables entering the building. The protected terminal shall be connected to the lightning protection ground. Where the length of the outside plant cable from the point it enters the

building to the BET is greater than 15 meters (50 feet), install the outside plant cable in metal conduit and ground the conduit to the lightening protection ground. Terminate twisted-pair outside plant copper cable on BETs at the point where it enters the building.

10.2.10 Lighting

Lighting for the main terminal space shall be a minimum of 500 lux (50 foot candles), measured 1 m (3 ft) above the finished floor. The lighting should be controlled by one or more switches located near the entrance door.

NOTE: Lighting fixtures should not be powered from the same electrical distribution panel as the telecommunications equipment in the main terminal space. Dimmer switches should not be used and emergency lighting and signs should be properly placed such that an absence of light will not hamper emergency exit.

10.2.11 Fire suppression/Sprinklers

Fire protection of the CER shall be provided per applicable code.

If sprinklers are required within the equipment area, the heads shall be provided with wire cages to prevent accidental operation. Equipment not related to the support of the CER (e.g. piping, ductwork, water/sewage lines, pneumatic tubing, etc.) should not be installed in, pass through, or enter the CER.

10.3 Cable Trays

Cable trays shall be supported in accordance with the recommendations of the manufacturer for maximum cable load, but at no more than 6-foot intervals. Provide 1 sq inch (650 sq mm) cross-sectional area of the tray for each outlet location served. Cable trays shall be designed to accommodate a maximum calculated fill ratio of 60% to a maximum inside depth of 6-inches (150 mm). Cable trays shall not be placed more than 30" above a false ceiling and installed free from obstacles that will restrict access for installing and troubleshooting cables. A minimum of 300mm (12") access headroom shall be provided and maintained above the cable tray and other building components (e.g. air conditioning ducts, pipes, other cable trays, ceiling, etc.) and they should not restrict access. Designers must coordinate with other disciplines to ensure clearances can be achieved. The cable trays within a CER shall be installed at least 12" above the racks. Waterfall fittings shall be used as required to support cabling. The cable trays within the CER shall be grounded to the Signal ground busbar in the CER in accordance with the provisions of Article 318, NFPA 70 and J-STD-607-A. Cable trays shall not pass through smoke and fire partitions. Cables that run through smoke and fire partitions shall be contained inside 4-inch fire rated pathways. Sufficient number of pathways shall be installed to allow for at least 40% expansion once all planned cabling is installed.

10.4 Manholes/Handholes

All new communications manholes/handholes planned for installation on WPAFB shall be pre-cast concrete unless site conditions do not allow for this, and then cast in place concrete manholes/handholes can be considered. Only concrete manholes/handholes are allowed for communications cabling. The designer shall coordinate the proposed manholes/handholes with the 88 CG. All manholes/handholes will be communications type, and include cable racks on all sides and corners, cable pulling eyes on all walls, opposite duct banks, a sump located under the opening, a 3/4" X 10' copper ground rod, and bonding ribbon encircling the manhole and attached to the ground rod (manholes only). All measurements are inside dimensions. The metal frame dimensions are dependent upon depth from the concrete top of manholes/handholes to grade level. Manholes/handholes should be installed so that a minimum number of rings are required to be level with finished grade (no more than 12"). The entrance opening shall be 30 inches unless larger openings are specified by the infrastructure engineer. The metal cover shall be equipped with a Pentagon Head bolt type frame and cover with a communications logo. Manholes/handholes around critical or major facilities, or located outside the Base fence line may require more security; coordinate with the 88 CG Program Manager for guidance. Duct bank configurations entering/leaving the manholes/handholes must be considered when rebuilding or installing new manholes/handholes. Ducts shall be installed at different heights from ducts on adjacent walls, so cables placed in one duct will not block another duct in an adjacent wall (see figure 5). All manholes/handholes shall be equipped with communications type cable racking on all walls. Each manhole/handhole shall be equipped with pulling irons across from each duct bank entrance. Contact the Base Communications Project Manager when conditions affecting communications infrastructure exist. See figure 5 for typical manhole.

Typical Manholes/Handholes

Manhole or Hand-hole Size	Copper Cable	Fiber Cable	Splice Case(s)	Comments
2'6" x 2'6" x 3'	1 to 4 cables each at 600 Pr or less	Yes	No	Used for small copper / fiber optic cable pull through installations
4' x 4' x 4' or 4' x 4' x 6'	1 to 4 cables each at 600 Pr or less	Yes	No	Used where cables are installed or pulled through or at building entrances.
5' x 4' x 4'	1 to 4 cables each at 600 pairs or less	Yes	Yes	Used where one to four copper cables with splicing (only one copper splice) or fiber optic cables are installed.
6' x 6' x 6'	1 to 6 cables at 1800 pairs or less	Yes	Yes	Used where one to six copper cables or fiber optic cables are installed with splices or pulled through or at building entrances and additional depth is needed
8'6" x 5'6" x 7'	1 to 6 cables each at 3600 pairs or less	Yes	Yes	Standard size manhole for most inline conduit/duct installations with or without branch conduit/duct lines. Support copper cables up to 6 each 3600-pair copper cables with 12.5" diameter splice cases.
10' x 7'x7' or 12' x 7'x7'	Used for large number of conduits and/or cables	Yes	Yes	should be installed based upon the number of conduits/duct entrances supported; for example, where nine or more conduits enter the manhole to support future requirements.

Table 3

NOTE: Handholes are for pull-through only and not designed for splicing activity.

10.4.1 Cast-in-Place manholes: Cast-in-Place method for rebuilding manholes is used only when surrounding conditions are the prevailing factor.

10.4.2 Airport rated manholes are standard for those areas of the flight line where aircraft safety is a factor.

10.4.3 Traffic rated type manholes are used when traffic conditions warrant – where vehicles may drive over them on other than an occasional basis.

Typical Grounding

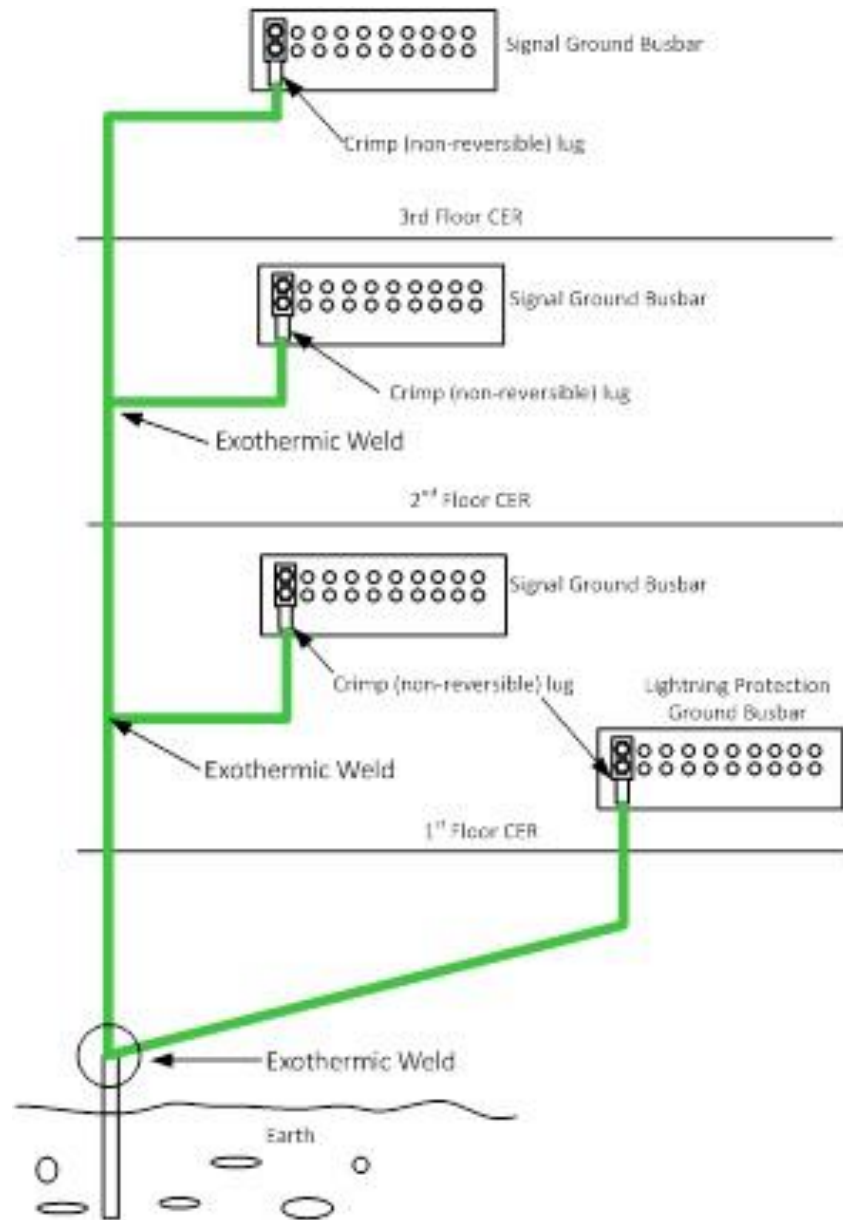


Figure 4

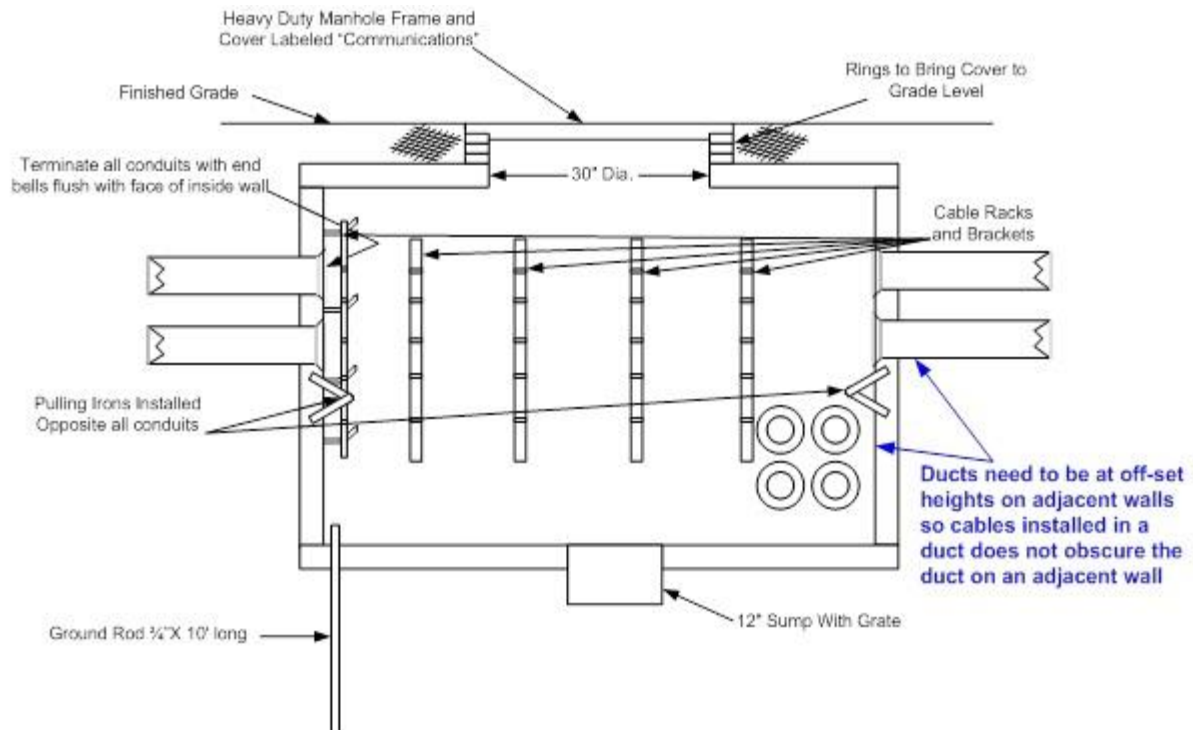


Figure 5 (Typical Manhole)

10.5 Conduit

All new buildings will have a minimum of two 4-inch conduits run from the main CER to the communications manhole duct system (See CER sizing, Table 1). For large buildings additional conduits may be required based on cable requirements. All conduits throughout the building shall comply with the National Fire Protection Association (NFPA) 70 (National Electrical Code) and NFPA 101 (Safety to Life from Fire in Buildings and Structures). The minimum bend radius of conduits shall be as recommended by the manufacturer, but shall not be less than twice the minimum bend radius of the cable passing through it. Conduits over two inches shall not contain any 90-degree bends; pull boxes will be installed in place of bends. Conduits 2-inches or smaller shall not contain more than two 90-degree bends or the equivalent. However, a pull box may be installed after two 90-degree bends or their equivalent to comply with these limitations. Individual conduit runs shall not exceed 100-feet in length without having a pull box installed and shall be supporting in accordance with NFPA 70.

10.5.1 Inside Buildings

Electrical metallic tubing (EMT) conduit must be installed from the cable backbone distribution system, whether cable tray or enclosed duct, to each outlet. Conduit for standard outlets must be a minimum of 1 inch (27mm) EMT conduit and run from the outlet box to the cable tray or enclosed conduit. In addition, any communications conduits run through the floor must be sized at no smaller than 1-inch per three jacks serviced (or one comm. outlet); this can be done by using multiple conduits or larger size conduits.

10.5.2 Outside Plant

All new buildings will have a minimum of two 4-inch conduits run from the main CER to the communications manhole duct system (See CER sizing, Table 1). The only exception is small buildings (less than 10,000 Sq Ft) they will have a minimum of one 4-inch duct for very small, two 4-inch ducts for others. For large buildings additional conduits may be required based on cable requirements. One conduit shall have at least three, three cell MaxCell installed for fiber optic cables. If only one conduit is installed for a small building, it shall have at least three, three cell MaxCells installed for both copper and fiber optic cables.

All new conduits installed between manholes/handholes or from a manhole into one of the Dial Central Offices (DCO) or a major copper cable distribution facilities (such as comm. huts) shall be 5-inch diameter. One of the conduits in the bank of conduits between manholes/handholes or entering a building shall be filled with the max number of three cell MaxCells to allow for installation of the maximum number of fiber optic cables.

All conduits shall be schedule 40 PVC or better.

All conduits entering manholes/handholes or buildings shall have bell ends installed flush with the inside wall of the manhole/handhole (see Figure 5), or building entrance when conduit terminates in a horizontal wall. Conduits that enter a Comm. room through the floor shall be installed in a manner that they will be one inch from the plywood mounted on the wall and extend at least one inch above finished floor, but no more than three inches above finished floor (see Figure 6), and have a protective bushing on the end of the conduit to protect the cabling. Any conduits that enter/exit a comm. room through a wall or ceiling shall be installed in a manner that they will protrude 1-3 inches from the wall/ceiling and have a protective bushing on the end of the conduit to protect the cabling (see figure 6).

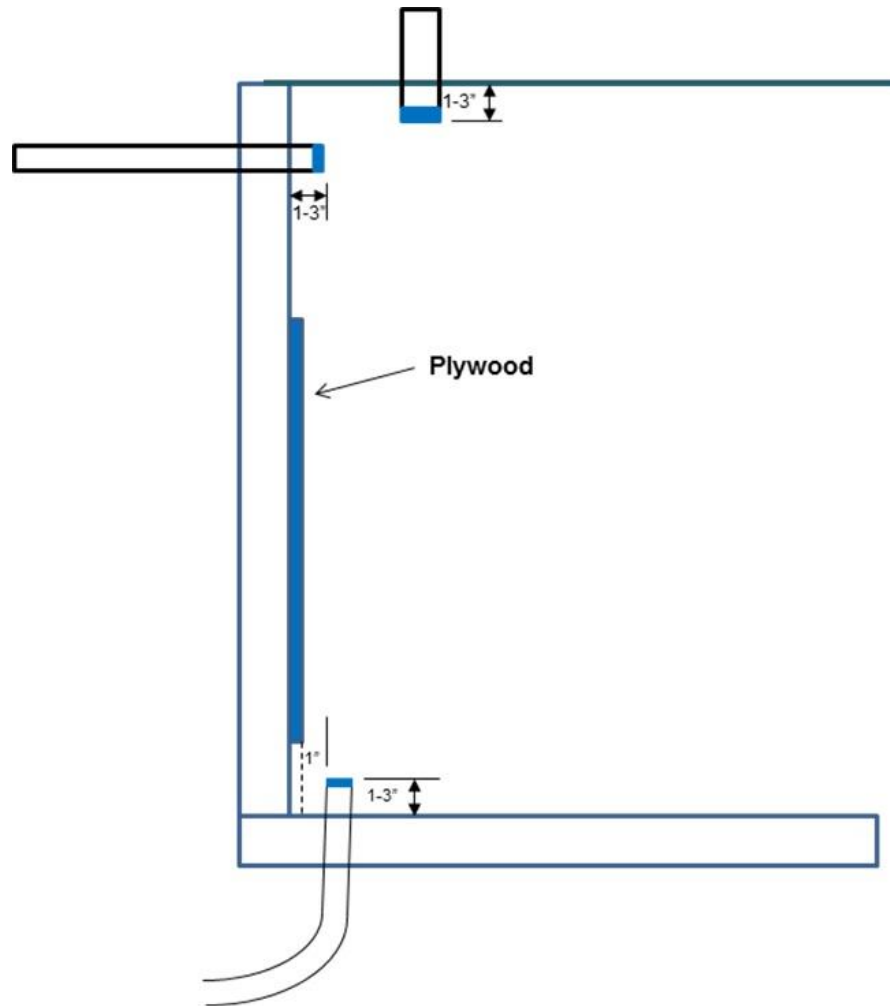


Figure 6

All conduits installed under roads, parking lots or other areas where vehicle traffic is authorized, or where a minimum 36" depth cannot be met shall be concrete encased. Concrete encasing shall extend at least five (5) feet beyond edge of paved area. All paved areas shall have all fill compacted to prevent settling of the pavement once restored. The patched area shall be slightly over filled to allow for any settling and the edges sealed. Directional boring may also be used in these situations and others when trenching or excavating is not practical or is cost prohibitive (e.g., crossing of runways, taxiways, waterways, and environmentally sensitive areas).

10.6 Pull Wire/Ropes

A nylon pull rope/tape shall be inserted in each empty conduit/inner duct or any conduits still having remaining cable capacity. The nylon pull rope/ tape shall have a capacity of not less than 200-pounds tensile strength. Not less than 24-inches of slack shall be left at each end of the nylon pull rope/tape.

10.7 Pull Boxes

Pull boxes shall not be less than the minimum size required by the NFPA 70 and shall be constructed of galvanized steel, except where cast-metal boxes are required. Pull boxes shall be furnished with screw-fastened covers.

10.8 Copper Cable Splicing

10.8.1 Copper conductor splicing method

The fold-back splicing method using MS2 (3M) type straight splicing modules shall be used to complete all new splices. Reference 3M MS2 Modular Splicing System Practice 78-8130-4094-2-A

10.8.2 Splice Cases

Preformed stainless steel cases shall be installed on all completed splices in accordance with the manufacturers recommended installation procedures. Each splice case shall be pressure tested to ensure water/moisture tight seal. All splice cases and cables shall be racked and secured to manhole wall mounted cable racks and hooks in accordance with approved technical standards.

10.9 Voice and Data Cabling

10.9.1 Non-secure CERs/work areas

Three category 6 blue round cables and one pull string (for additional cable or fiber runs) shall be installed at each location where voice and/or data jacks are required (refer to figure 7).

For facilities where Voice Over Internet Protocol (VOIP) is planned to be used to support voice requirements, two of the latest TIA approved category cables and a pull rope shall be installed at each location where voice and/or data jacks are required (during initial design coordinate with the 88 CG Project Manager for this determination) (refer to figure 7).

Customer requirements may call for more than two or three of the latest TIA approved category drops at each outlet location. In cases where the customer requires private networks additional drops will be required. These requirements and the subsequent design needs to be reviewed/approved by the 88 CG.

The latest TIA approved category cabling must meet the specifications to support Gigabit Ethernet and at least 500 MHz bandwidth. These cables shall be clearly labeled and have maintenance loops installed IAW BICSI standards. When installing cabling, the wall plate jacks shall be wired at the CER patch panel in consecutive fashion. Example, at the first

wall plate location there should be three wall jacks that connect to patch panel A, jacks 01, 02, and 03. The three jacks on the second wall plate will connect to patch panel A, jacks 04, 05, and 06 and so on. The total length of these cables from CER to wall plate cannot exceed 90 meters (295'). A minimum quad RJ-45 outlet will be installed at each location, and the cables will be terminated in the CER on appropriate category patch panels. Tie wraps will not be used to bundle or secure these cables. When bundling or securing is required Velcro tape shall be used. See the "88th Communications Group Labeling Requirements for Communications" (Annex 1) for standards to be followed for cabling, to include connector types for classified and unclassified networks. Adjustments must be approved by the 88 CG project manager. All cable not installed in plenum rated conduit, that utilizes air-return space within ceilings/floors must be plenum rated.

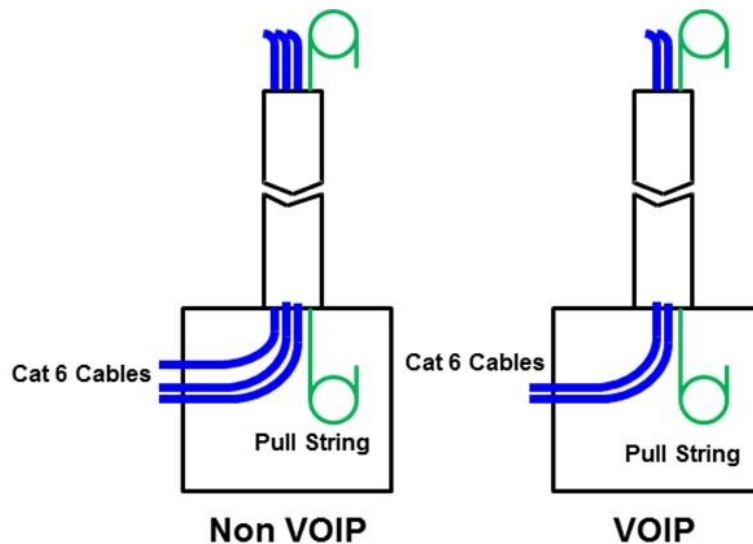


Figure 7

In each CER the appropriate number of 110 wall mount punch down blocks will be installed on the wall and have the latest TIA approved category cables run to the latest TIA approved category patch panels installed in the rack below the patch panels that go to the user jacks. The wall mount 110 blocks are to be started no higher than 68" above floor down to no lower than 30" above floor. These will be used to cross connect the voice riser cables to the patch jacks to the user location (see figure 8 & 9). The number of patch panels required for this shall be equal to the number of pairs in the copper riser cable entering the CER. Example – if the copper riser cable has 200 pairs in it, then 200 of the latest TIA approved category jacks are required in the patch panels that connect to the wall mounted 110 blocks.

10.9.2 Secure CERs/work areas

In secure work areas where classified as well as unclassified networks are used the area will typically use multi-mode (62.5 micron laser enhanced) fiber optic cabling to the desktop for all the data systems and the latest TIA approved category Copper cabling for voice systems (see figure 10 & 11). WPAFB has standardized on using color-coded Panduit "keyed" LC connectors at the user end and standard LC connectors in the comm. room. (See the "88th

Communications Group Labeling Requirements for Communications” (Annex 1) for standards to be followed for cabling, to include connector types for classified and unclassified networks)

In those areas designated as secure vault areas, the horizontal distribution cables shall be wired directly from the secondary CER(s) located inside the secure areas to the work station information outlets inside the designated area. In those areas designated as secure vault rooms, all voice and data cables shall conform to current security requirements. The design will be coordinated with the 88 CG assigned network engineer.

10.9.2.1 Exposure of signal lines carrying unencrypted, classified information within controlled access areas (CAAs)

CAAs must be designated in writing and meet the procedural and physical requirements defined in AFSSI 7703, para 11. Within CAAs, wire or fiber-optic signal lines carrying unencrypted, classified information (hereafter identified as RED signal lines) must be exposed to viewing. However, RED signal lines may be run in conduit (electrical metallic tubing (EMT), Panduit, or other distribution facilities) to protect them from damage or achieve neatness and orderliness, as long as they are exposed to viewing and begin and end within the same CAA.

Within a CAA that is manned 24/7 and has true floor-to-ceiling walls, RED signal lines may be run above a false ceiling or below a raised floor, with the requirement that the user organization check the RED signal lines for tampering twice a year or whenever unclassified personnel (e.g. housekeeping, painting, CE work, etc.) have had access to them. Within a CAA that is manned 24/7, but does not have true floor-to-ceiling walls, RED signal lines may be run beneath raised flooring without conduit. RED signal lines may be run above a false ceiling provided the hidden area they traverse is alarmed or the RED signal lines are run in conduit with the conduit ends exposed below the false ceiling and all joints of the conduit are spot-welded or epoxied. If not alarmed, the user organization must check RED signal lines for tampering twice a year or whenever unclassified personnel have had access to them.

Within a CAA that is not controlled 24/7, RED signal lines may be run above a false ceiling or below a raised floor provided the hidden area they traverse is alarmed or the RED signal lines are run in conduit with each end of conduit ends exposed below the false ceiling or above the raised floor and all joints of the conduit are spot-welded or epoxied. The user organization must check RED signal lines for tampering twice a year or whenever unclassified personnel have had access to them. RED signal lines may NOT be run within walls without prior approval of the Base EMSEC Manager and the Air Force Certified TEMPEST Technical Authority (CTTA), coordinated through 88 CG Project Manager.

10.9.3 SIPRNET in unclassified work areas

When a requirement exists for SIPRNET in an unclassified office/work area this is satisfied by placing an encryption device (normally a TACLANE), a small switch, and a PC in that office. Four (4) strands of multi-mode (62.5 micron laser enhanced) fiber is run from the nearest CER to that area and terminated on LC connectors on the work area end and red LC connectors in the CER.

10.9.3.1 Exposure of lines carrying unencrypted, classified information in unclassified work areas

Expose all RED signal lines to viewing. Exposing means do not hide RED signal lines above false ceilings, below raised flooring, within walls, or behind a cover attached to walls.

10.9.4 Copper Riser Cables

The riser cable to a satellite CER shall be sized to at least 140% of the maximum number of personnel that can be served from the CER. Example; 125 personnel can fit into the area served by a CER $125 \times 1.40 = 175$ pair. In facilities where VOIP will be utilized for voice the amount of copper that needs to go to each satellite CER can be reduced. The copper can be reduced to 50% of the number of personnel that will be serviced from the CER. Example 125 personnel can fit into the area served by the CER $125 \times .50 = 63$ pair. In this case round down or up to the closest standard size cable, example, 74 or less round down to 50 pair, 75 or higher round up to 100 pair. Since copper cables normally come in 50, 100, 200, 400, 600 pair sizes a 200 pair riser shall be used in this case. Riser copper cabling shall be terminated on appropriate category 110 type wall mounted blocks, with space left for expansion (see figure 12 & 13). A minimum 36" of unobstructed work space in front of the blocks shall be maintained to allow sufficient workspace. Cables shall be installed according to BICSI standards.

Horizontal distribution cables not installed in conduit or wire ways shall be properly secured and neat in appearance. Cables servicing alarm panels shall be terminated on appropriate demarcation blocks within the nearest CER. All cable not installed in plenum rated conduit, that utilizes air-return space within ceilings/floors must be plenum rated.

10.9.5 Combat Information Transport System (CITS) Wireless Network Connections

Wireless network equipment should be considered for all conference rooms, class rooms, auditoriums, etc. and when required by customer. Installation of this equipment will require dual latest TIA approved category drops be installed as specified by the 88 CG Network Engineer, usually above a dropped ceiling or just below (this will be identified by engineer). Usual configuration is three-four wireless devices to cover a room or room-sized area.

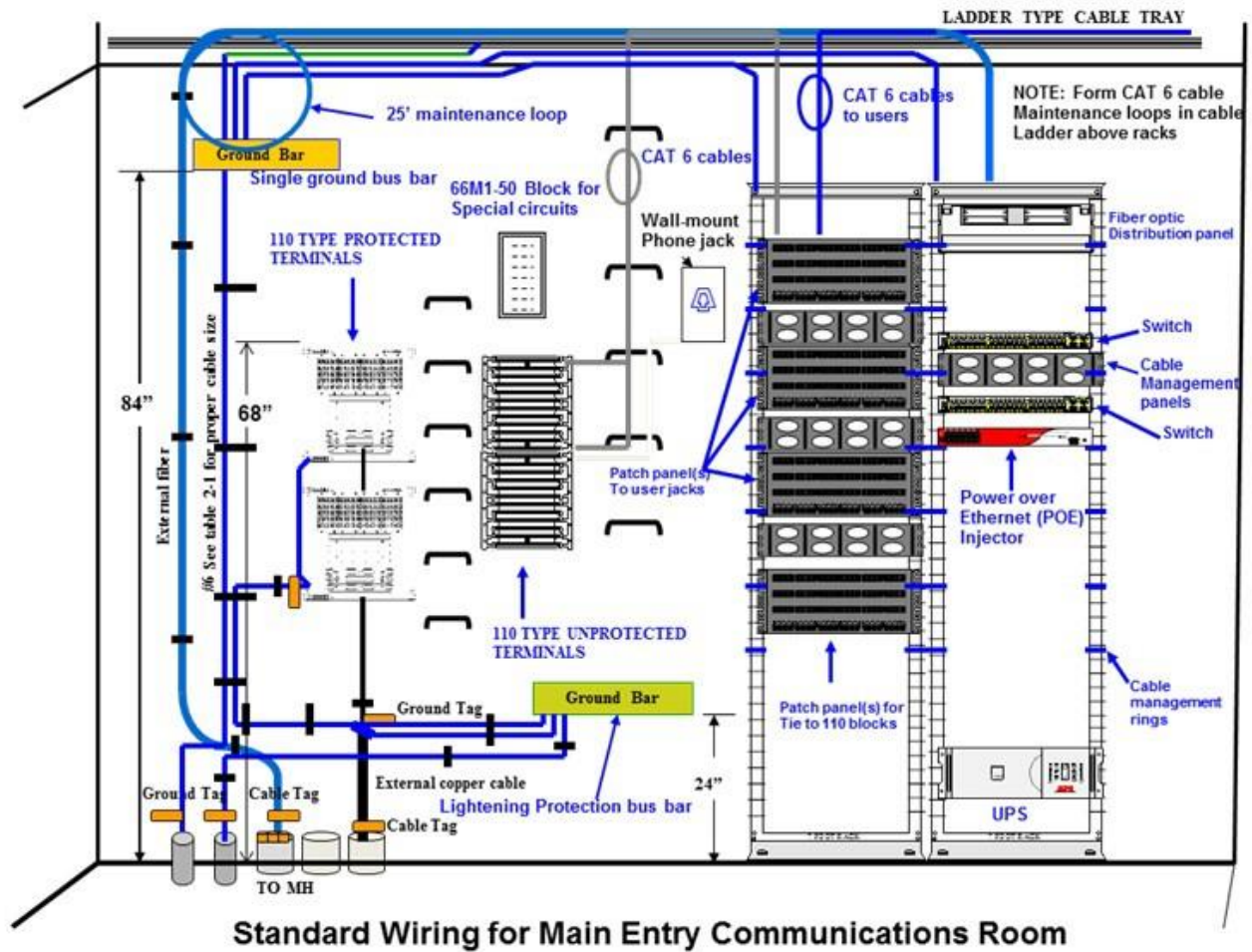


Figure 8

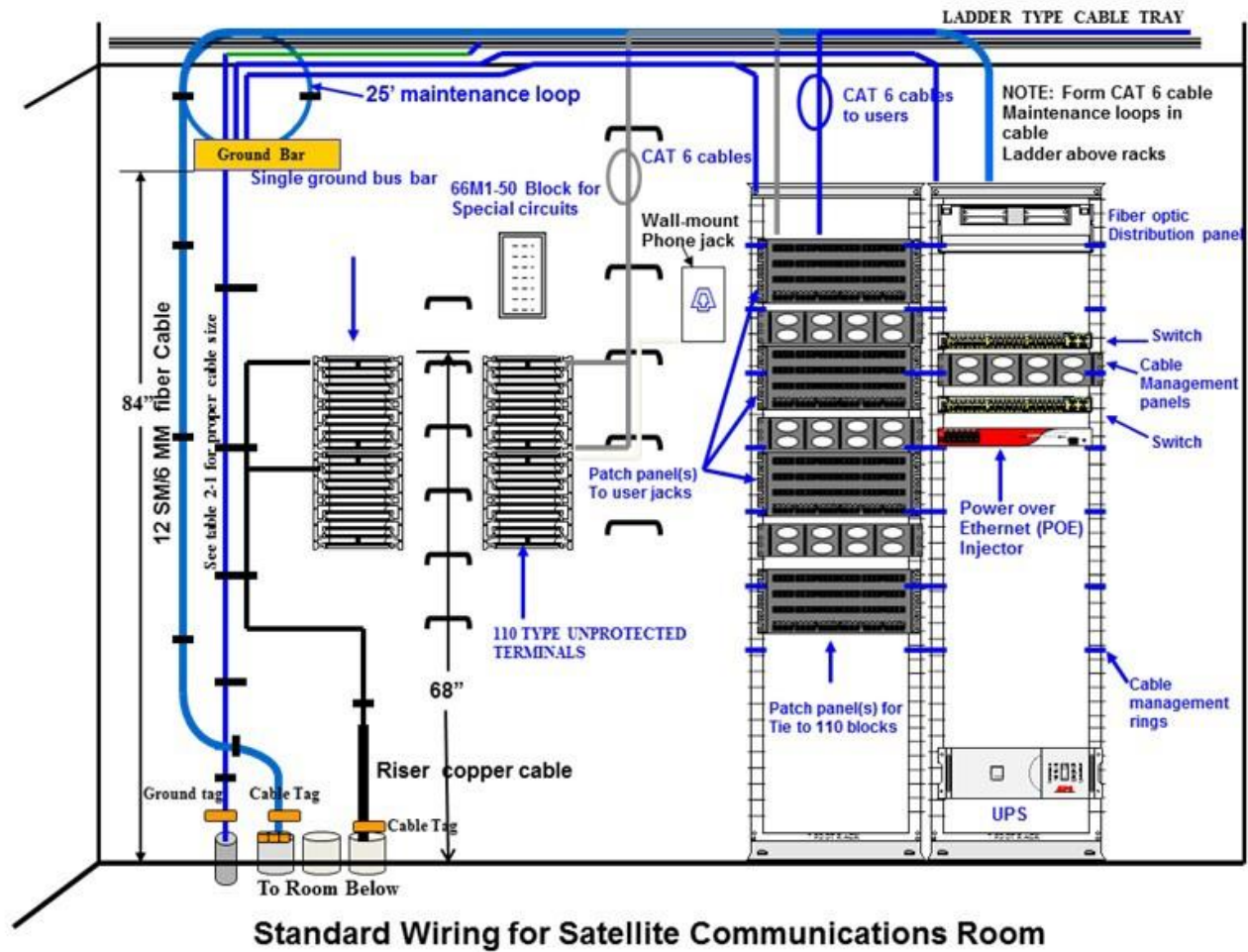
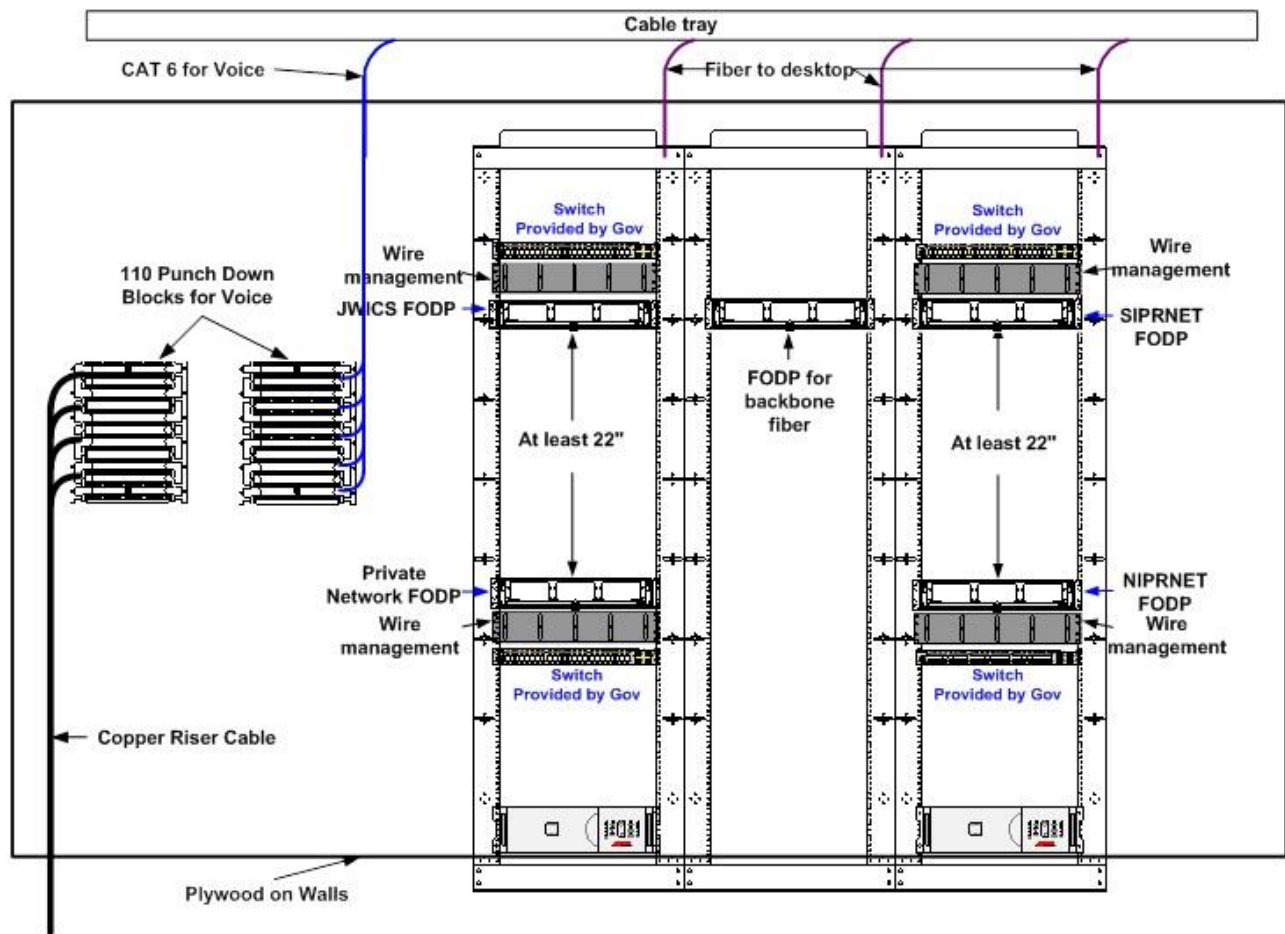
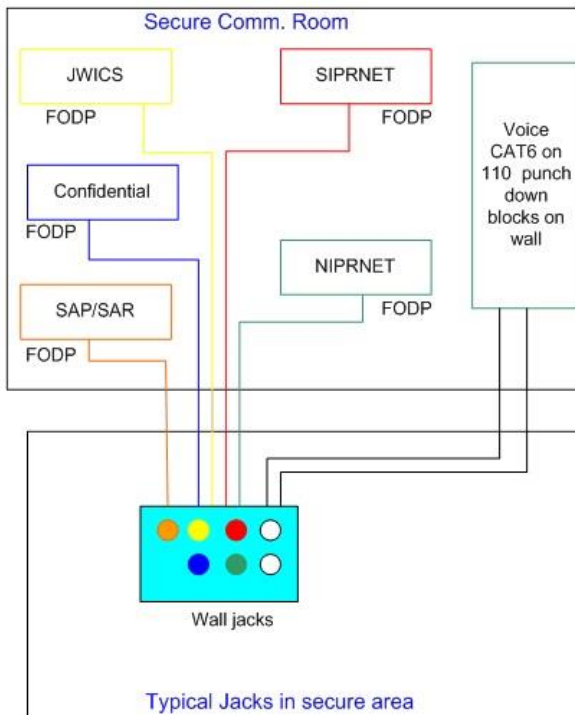


Figure 9



Standard Secure Communications Room layout

Figure 10



Run the following to each comm drop (as appropriate) location in secure room:

Two strands of multi-mode fiber from JWICS FODP (terminated with yellow LC connectors) and terminate on yellow keyed LC type connectors at the user wall jack.

Two strands of multi-mode fiber from the Confidential FODP (terminated with blue LC connectors) and terminate on blue keyed LC type connectors at the user wall jack.

Two strands of multi-mode fiber from the SIPRNET FODP (terminated with red LC connectors) and terminate on red keyed LC type connectors at the user wall jack.

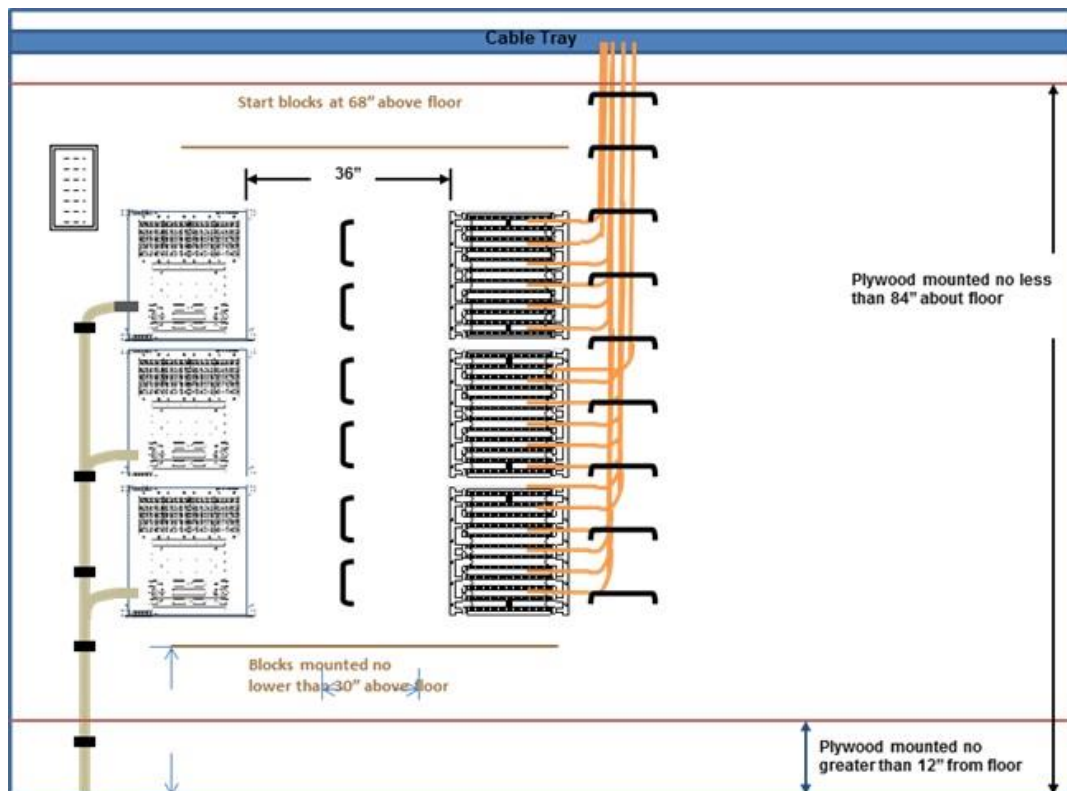
Two strands of multi-mode fiber from the NIPRNET FODP (terminated with green LC connectors) and terminate on green keyed LC type connectors at the user wall jack.

Two strands of multi-mode fiber from SAP/SAR FODP (terminated with orange LC connectors) and terminate on orange keyed LC type connectors at the user wall jack.

Run two CAT 6 copper cables from the 100 type punch down blocks mounted on the wall of the comm room and terminate on white RJ-45 jacks at the outlet

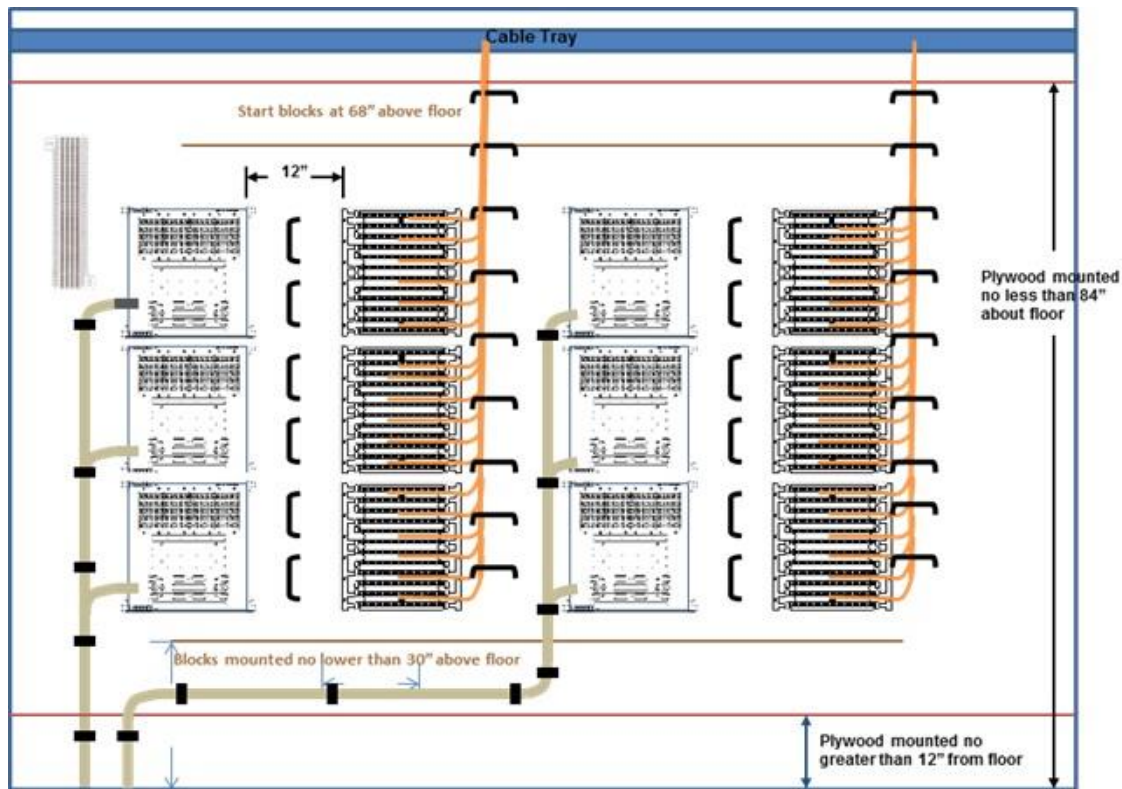
Secure Area Wiring Schematic

Figure 11



Typical Spacing for Wall Mounted Blocks (Single Row)

Figure 12



Typical Spacing for Wall Mounted Blocks (Double Row)

Figure 13

10.10 Copper Patch Panels

WPAFB has standardized on Ortronics products so only one manufacturer's parts will be required to stock for replacement. Patch panels will be mounted in 19-inch equipment racks in the appropriate floor's CER. All patch panels shall match the category cabling terminated on them and have sufficient patch cords provided to fully utilize the patch panels. Factory terminated and tested patch cord, TIA Category 6 will be used. Locally manufactured patch cords are not authorized.

Copper patch cables shall be provided for the patch panels in the CER. Enough should be provided to fill 80% of the horizontal (the cables that go to the wall jacks throughout the building) cable patch jacks. Patch cords shall be: Four pair, 100-ohm unshielded twisted pair (UTP) cable with 24 or 28 gauge stranded copper conductors and must meet the specifications to support Gigabit Ethernet and at least 500 MHz bandwidth. Provide with an 8-pin modular plug on each end, and TIA 568B pin/pair assignments. Provide factory strain relief boot on each end of patch cord. Provide documentation of factory testing to Category 6 requirements with submittals. 60% of the patch cables shall be colored blue for normal UNCLASS data and 40% white for voice (when VOIP is used in a facility for voice service all patch cables shall be blue, except 10% that shall be white for safety phones, wall phones, etc.). If any special networks are to be employed the 88 CG engineering may identify a different color patch cord for these special systems. As an average one third of each color's patch cables shall be 3-feet in length, one third shall be 5 feet in length, and one third shall be 7-feet in length. In cases where a large number of patch panels are in a CER and

several racks are required, the patch cords will be of the appropriate length to allow for all required patch combinations. Exact sizes and quantities shall be coordinated with the 88 CG engineer and project manager.

10.11 Fiber-Optic Cable Patch Panels

The CER shall have rack mountable fiber-optic patch panels equipped with connector module housing, jumper storage module, connector panel modules, and LC-type connector coupling sleeves. See the “88th Communications Group Labeling Requirements for Communications” (Annex 1) for connector type and color of jumpers for classified systems. The patch panels shall be complete with labels and jumper retainers. Connector panel modules and coupling sleeves shall be required to terminate fiber-optic strands.

Sufficient fiber patch cords, of the correct type (single/Multi-mode), shall be provided to fully utilize the patch panels. Factory terminated and tested patch cords, with appropriate type connectors (Coordinate with 88 CG PM on type and lengths, correct type as called out for classified systems) will be used. Locally manufactured patch cords are not authorized. These patch cords should be a mix of lengths, half 3-feet and half long enough to reach farthest patching combination, if longer than three feet. They should be yellow for single mode (backbone), orange for multi-mode (backbone) and the appropriate color and ends as identified for classified systems.

10.12 Equipment Racks

The CER shall contain equipment racks that are 19-inches by 84-inches in dimensions and shall be used to house patch panels, concentrators, switches, etc. These racks must be strong enough to hold up to 400 pounds without bending, twisting, or swaying. The equipment cabinets/racks shall be free standing, secured to the floor, and have a minimum of two 20 Amp power outlets, from separate branch circuits, mounted on the rear. Check with 88 CG for special power requirements depending on equipment to be installed. The cabinets/racks will have a minimum 36-inches maintenance space in front and rear, **when allowing for installed equipment**. When two or more racks are installed they should be of the same size/dimensions and style, mounted side-by-side with vertical cable management between them and bolted to the floor, one rack can have the side against the wall, but there must be at least 36-inches from the farthest rack from the wall to the opposite closest wall. The equipment racks shall have both horizontal and vertical (vertical wire management should be the cage type) wire managers for routing cabling. Vertical cable management shall be sized to allow for maximum fill if all patch cables were installed. All cabinets/racks shall be individually grounded to the CER signal ground.

The following are the standard types of racks to be used in all CER's:

CERs will have 7-foot racks that meet the following specifications:

- Black in color
- Height 84” (2.1 m)

- Width 23.75" (603 mm)
- Depth of base 16.50" (419 mm)
- 10.5" channel depth (When larger numbers of the latest TIA approved category cables are called for 16.25" racks will be required, check with 88 CG PM for detailed design)
- EIA hole pattern front and rear
- Open channels top and bottom for routing cabling
- 44-rack units, front and back
- Secured to the floor without front-to-back or side-to-side motion once secured
- Secured to walls (when wall mount racks are called for)

Adequate cable management panels shall be called out and installed in all racks that have patch panels to provide a neat and properly supported installation of patch cords. Ortronics "MIGHTY MO", model OR-MM6710 or OR-MM6716" or equivalent are recommended.

For small installations where wall mount cabinets are used, WPAFB has standardized on TERAX2 cabinets, which allows for the same keys to be used for access. See figure 14 for standard installation instructions. When enclosed cabinets are to be used, WPAFB has standardized on Great Lakes brand cabinets, again to have a standard access key.

For Small facilities with 45 or less computer connections and no space for a comm. room the use of a TERAX2 cabinet with a small protected copper 110 block and a 110 to RJ-45 block can be considered (ref to figure 15). Part numbers for recommended components is provided for reference, but final design shall be provided to the 88 CG Project Manager for review and approval.

Holocom Cabinet Mounting Method

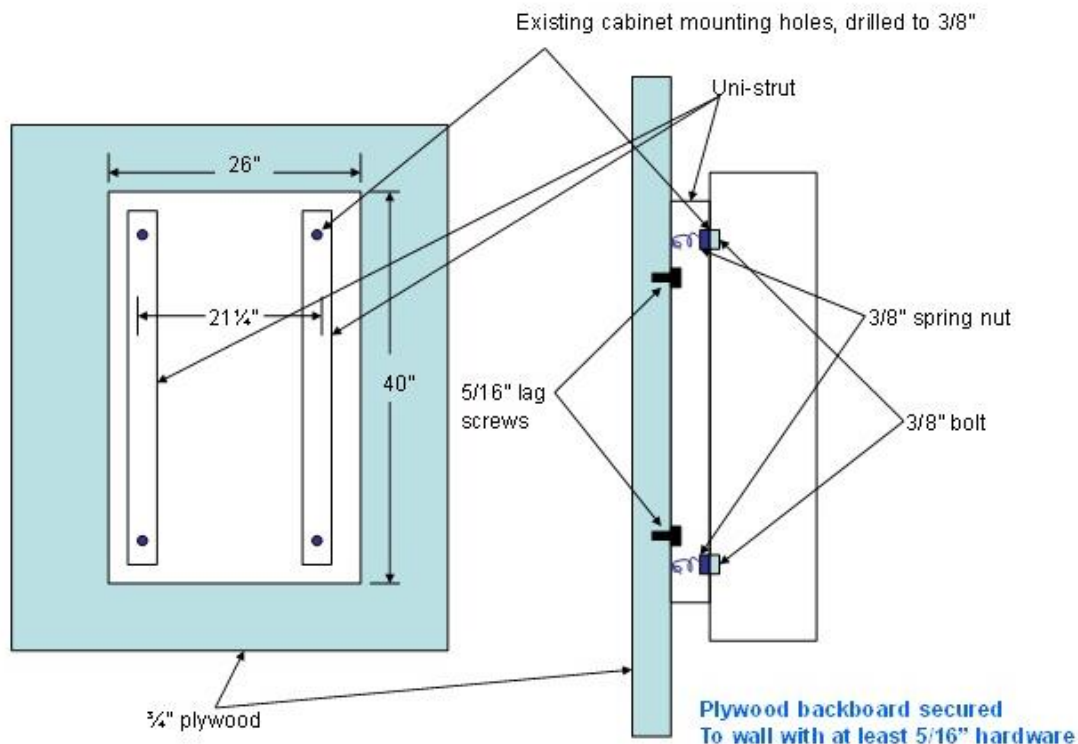
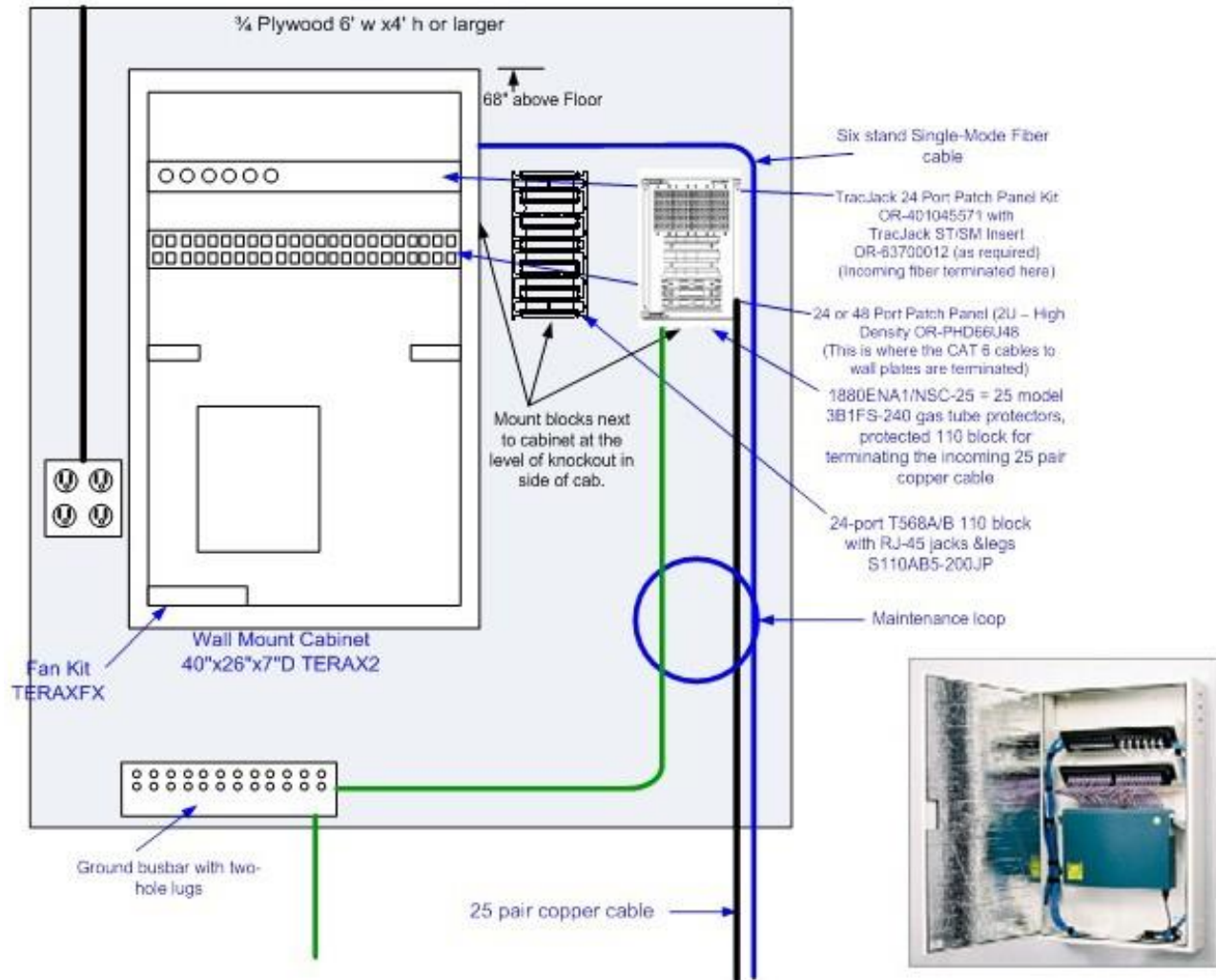


Figure 14



Recommended comm. installation for Small Facilities
Figure 15

Laptop storage requirements

When customer has the requirement to have laptops stored between uses laptop storage cabinets like one made by Dock & Lock Systems shall be used. These cabinets have 4-10 drawers that allow the laptop to be connected to power and a network while in storage. The cabinets shall have the power distribution and the latest TIA approved category network wiring kits ordered to allow for power and network connections. When a laptop storage cabinet is used at least four (4) strands on multimode (62.5 micron laser enhanced) fiber shall be run from the nearest CER to a wall jack near the rack and both ends terminated on LC type connectors. See figure 16 for example of cabinet.

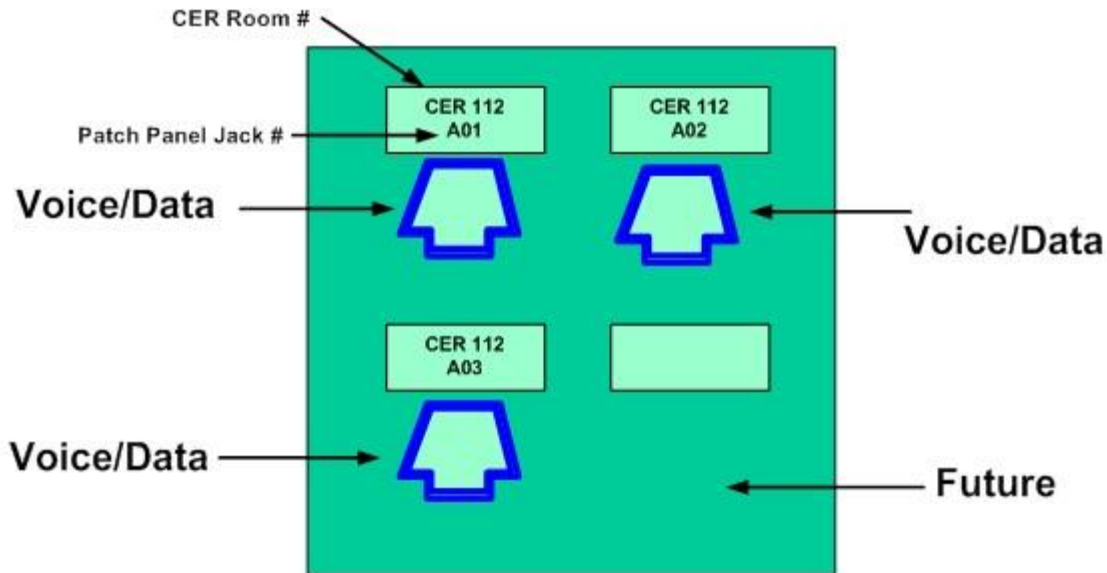


Figure 16

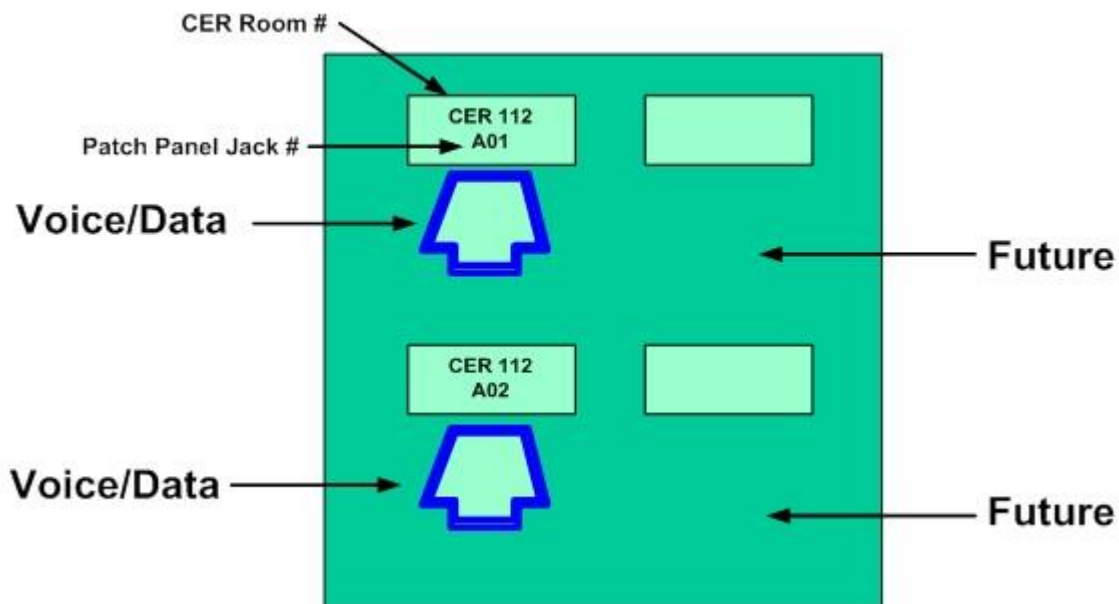
10.13 Information Outlets

10.13.1 Wall Mount Boxes

Voice/data outlets shall have four ports (three used and one spare for future use -- see figure 17) for an 8-position un-keyed modular RJ-45 type jack; three will be used with one spare location, unless changes are specifically identified. When VOIP is going to be used within a facility for voice support four port outlets shall be used, but only two shall have RJ-45 jacks installed, the other two will be blank for future expansion (see figure 18). All jacks will be wired to the T568B standard. Private offices, conference rooms, class rooms, laboratories, open areas, etc. should have a minimum of 1 quad outlet per 4.5 square meters (48 square feet) of net space. When more than one outlet is required based on room size, they shall be installed, at a minimum, on the two longest, unobstructed walls. The outlets shall be placed into standard commercial face plates mounted within the information outlet boxes. Outlets are to be a type such that a single modular jack can be replaced without affecting service on the other three. Ample 1-inch conduit to support appropriate fill ratios shall be run from the outlet box to the cable tray. There should be adequate space to accommodate the appropriate bend radius standards. Outlets should be located within 1 meter of an electrical outlet.



Non-VOIP
Figure 17



VOIP
Figure 18

10.13.2 Furniture Systems

Install voice/data outlets as for wall outlets. The specific outlet configuration shall be specified at the time the furniture vendor is selected. The building's furniture system shall have clusters of workstations fed from communications panel(s)/pole(s). Sufficient communications poles shall be installed to allow for additional cabling to be added in the

future, without crowding and kinking. For ease of access, any furniture that has cable paths/outlets at desktop level or higher is recommended. The preferred method to feed communications cables to modular furniture is from above the ceiling. In general, under floor conduit systems are not acceptable. However, under floor conduits may be used when there are no other means to provide access to the location. In addition, any communications conduits run through the floor must be sized at no smaller than 1-inch per three jacks serviced; this can be done by using multiple conduits or larger size conduits.

10.13.3 Floor Mounted Outlet Boxes

Install voice/data outlets as for wall outlets, but with ample conduits within the floor. There shall be at least one 1-inch conduit or 1 sq inch of duct space in the floor for every three-jacks serviced.

10.13.4 Special service outlets

Wall telephone outlets should be installed outside main entryways and outside the entrance of all secure areas, in mechanical/electric rooms, and CERs at a height which complies with the Architectural Barriers Act Accessibility Standards (ABA). Outlets that are to be used for alarms, elevators, etc should be provided with appropriate terminations and wired to the special circuit block in the nearest CER, for the end user equipment.

10.13.5 Environmental Monitoring System (EMS) outlets

One dual latest TIA approved category outlet shall be installed in each mechanical room where connection to the Base's central Energy Management System is required for connecting the HVAC control system, and should be labeled EMS. One dual network outlet shall be installed in the electrical room where the meter will be located and should be labeled UMS (Utility Monitoring System).

EMS and UMS network drops will be installed within proximity to the equipment of service whereas a device patch cable will not be required in excess of 15'. Patch cable provided shall be factory made; copper or fiber material shall be rated to match facility network specifications.

10.13.6 Device Cables

Ten foot latest TIA approved category device cables shall be provided equal to 1.1 times the number of location where jacks are installed. For example, if 100 three-jack (two-jack in VOIP facilities) locations are installed then 1.1×100 equals 110 device cables. This allows for connecting PCs and printers. These shall be four pair, 100-ohm UTP cable with 24 or 28 gauge stranded copper conductors. Provide with an 8-pin modular plug on each end, and TIA 568B pin/pair assignments. Provide factory strain relief boot on each end of device cable (color Blue for normal UNCLASS network, appropriate color for classified networks). Provide documentation of factory testing to Category 6 requirements with submittals. For classified areas that utilize fiber to the desktop fiber device cable shall be provided at the

rate of one per every jack at each outlet location, example ; 100 outlets, each outlet has a NIPRNET, SIPRNET, and JWICS jack, then 100 each of the appropriate color and connectors on the ends shall be provided for each type jack. (110 Green Keyed LC on one end and SC or ST on the other for NIPRNET, 100 Red Keyed LC on one end and SC or ST on the other end for SIPRNET, and 110 Yellow Keyed LC on one end and SC or ST on the other end for JWICS). Coordinate with the 88 CG Project Manager on what type connectors are required.

10.14 Fiber-Optic Backbone Cables

Between CERs composite fiber optic cables shall be installed to connect the network switching equipment. This cable shall be a minimum 12/6 single/multi-mode cable. The single-mode cable will be 8.3/125 and the multimode cable will be 62.5 micron laser enhanced buffered fiber.

Areas that require plenum fiber-optic cable shall have fiber-optic cable covered by a UL listed NEC OFNP jacket for plenum applications or be installed in plenum rated inner duct. The fiber-optic cables that penetrate a wall of an area designated as a secure vault area must be TEMPEST compliant. The cables shall have a minimum 15-foot maintenance loop on each end of the cable for future reconfiguration.

In-ground fiber optic cables shall be installed in MaxCell or inner duct and have a minimum of 50-foot maintenance loops every third manhole and a 30 foot maintenance loop at each termination point. A minimum 12 strand single-mode fiber cable shall be installed from any new facility or facility that doesn't currently have fiber optic cable, to the designated Information Transfer Node (ITN) building. If the new/renovated facility will be designated a critical facility, then a 12 strand single-mode fiber cable shall be run in diverse paths from the new facility to two different ITNs. If the new/renovated facility will be designated an ITN, then a minimum 36 strand single-mode fiber cable shall be run in diverse paths from this new facility to two separate ITNs. Larger or composite fibers may be called for in some facilities, the 88 CG Project Manager and 88 CG Cable Engineer will identify any special requirements.

10.15 Fiber-Optic Connectors

All inter-building (building-to-building) and intra-building (within building) backbone fiber-optic strands shall be terminated using LC-type hot-melt, anaerobic, or fusion spliced fiber optic connectors with ceramic tip and connected to fiber optic distribution panels (FODP). Maximum insertion loss must not exceed 0.5 db. Refer to the "88th Communications Group Labeling Requirements for Communications" (Annex 1) for connector type and color of jumpers for fiber optic distribution systems used for horizontal connectivity for classified systems from the CER to the wall plate.

10.16 Fiber Splicing

The fusion splicing method shall be used for all fiber splicing. Re-enterable splice cases shall be used to allow for future splicing. Fiber cable shall only be fusion spliced at a location where smaller fibers are broken off of a larger fiber to feed multiple locations, or at the termination end when factory terminated stub cables are used. Fiber splicing will not be allowed just to extend a cable instead of running new from main splice point to end or end to end. An exception to this needs to be coordinated with the 88 CG PM and will only be considered when the cable length is over 1000 feet or when some other compelling reason is given and approved. Splicing cause's loss in the cable so is only used when absolutely necessary.

10.17 Punch Down Blocks

All punch down blocks, used to terminate the copper cable that feeds the building or is used between CERs shall be attached to the fire rated plywood on the CER walls using stand-off brackets. In new facilities or major renovations (where all the cabling to any given CER is being replaced/upgraded) shall utilize 110 type punch down blocks. In existing facilities where cabling is just being added, any new blocks shall match the type already in use in that CER.

10.18 Labeling

Cables/Outlets: See the "88th Communications Group Labeling Requirements for Communications" (Annex 1) for details on all communications labeling. The 88 CG should be provided with a map/drawing of installed cabling with its assigned numbering and a cross-reference spreadsheet indicating cubicle number and associated voice/data cable numbers. Spreadsheet should be in Excel format or equivalent.

10.18.1 Labeling MDF, Frames, Bays, etc...

Designations should be applied to racks, frames, bays, terminal strips, components, and the terminal sides of apparatus mounting plates immediately after installation or modifications. After the designations applied are thoroughly dry, they should be protected by a coat of clear shellac. Designations must be placed in such a manner that they may be easily observed. Do not obscure manufacturer's code marking. The letter size of a major floor item should be 3/4", group designations should be 3/8", and functional designations either 1/8 or 3/16". Markings can be done with cut-out stencils, rubber stamps, nameplates, or decals. Modifications should be made to agree with the job drawings. Additional stenciling required by the job drawings must be performed.

10.18.2 Documentation

Documentation shall be provided for entry into the 88 CG communications system. For outside plant cables the records must include (1) cable number, (2) cable pair assignment, (3) terminal number and location, (4) manhole butterfly drawings, and (5) manhole/duct area

drawings, showing exact route and placement of all new. For inside facilities the records must include (1) floor plans showing location of all outlets, CERs and cable paths, (2) detailed floor plans for all CERs, (3) rack layout drawings for all racks/cabinets in the CER, and (4) drawings of each wall of the CER that has cables, or equipment on them.

10.19 Cable TV Infrastructure

The wiring within a facility for cable TV service shall be “homerun” RG6U Quad shielded coax cable. Each outlet shall be run back to the nearest CER and terminated on a bulkhead connector mounted on wall of the CER. Cables shall be terminated with F type connectors. The cable TV provider will run the cable connectivity to the building and between CERs. The location of this equipment in any CER shall be coordinated with the 88 CG Project Manager.

10.20 Testing

All outside plant cables shall be tested pre and post installation as per paragraphs 2.1 and 2.2 as appropriate. Any reused cabling and government furnished cables shall be tested by the contractor and a copy of the results provided to the 88 CG project manager prior to reuse or installation of the cabling. If anything is found wrong with the cable, this will immediately be brought to the attention of the 88 CG Project Manager and will not be reused or installed until the PM approves the cable's use or reuse. The same test shall be performed after installation and the results supplied to the 88 CG project manager.

10.20.1 Outside Plant Copper Cable Testing

Continuity test for shorts, grounds, and splicer's errors, i.e. reverses, opens, transpositions and split pairs, and loop resistance test shall be performed on all outside plant direct buried and underground distribution copper cable pairs prior to installation acceptance. Test results will be provided to the assigned 88 CG Project Manager in hard and soft copy. All deficiencies (cable/splicer errors) will be corrected prior to installation acceptance.

10.20.2 Fiber Optic Cable Testing

Two (2) optical tests shall be performed for all fiber-optic cables. These tests are (1) optical time domain reflectometry (OTDR), and (2) attenuation test. These tests shall be performed on the completed end-to-end span, which include the near-end pre-connected single-fiber cable assembly, inside plant as specified, and the far-end pre-connectorized single-fiber cable assembly.

Any circuit that fails to pass the specified tests shall be reinstalled until it passes all tests. The cable plant will not be accepted until all circuits have passed.

10.20.2.1 Optical Time Domain Reflectometer (OTDR) Test

The OTDR test shall be used to determine the adequacy of the cable installations. The OTDR tests will show any irregularities, such as discontinuities, or micro-bending, improper splices, for the cable span under test. Hard copy fiber-optic signature records shall be obtained from the OTDR test for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, 1-m minimum, used as the delay line shall be placed before the near-end connector and after the far-end patch panel connectors for inspection of connector signature.

10.20.2.2 Attenuation Test

End-to-end attenuation measurements shall be made on all fibers, in both directions, using an 850 nm to 1300 nm light source for multi-mode, and 1310 nm to 1550 nm light source for single-mode at one end, and the optical power meter on the other. These tests will be used to verify that the cable system attenuation requirements, (quality factor db/km), conform to manufacturers specifications for length of cable and number of connectors and splices.

10.20.3 Network Copper Cable Test

The network copper cable plant test shall include the device cable, wall plate connection, horizontal run, to patch panel, and patch cable (see figure 19) and must pass the latest TIA approved category channel testing.

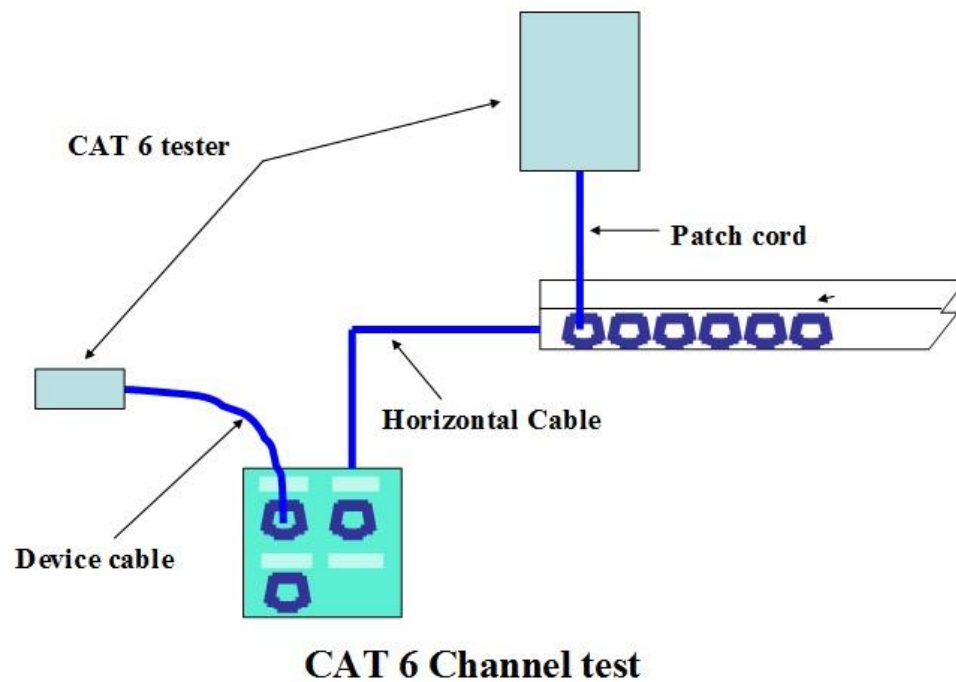


Figure 19

10.21 Codes and Publications

The publications listed below shall be referenced for all aspects of the building design. The publications are referred by the basic designation only. Latest publication, as of the respective date shall apply.

- American National Standards Institute (ANSI)
- ANSI C2 National Electrical Safety Code
- ANSI/TIA-607-B; Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- ANSI/TIA-607-B-1; Addendum 1, External Grounding
- ANSI/TIA-607-B-2; Addendum 2, Structural Metal
- ANSI/NECA/BICSI 607-2011; Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- Building Industry Consulting Services International (BICSI)
- Insulated Cable Engineers Association (ICEA) Specifications
- National Fire Protection Association (NFPA) Codes
- Telecommunications Industry Association/Electronics Industries Alliance (TIA/EIA)
- TIA/EIA-492AAAA; Detail Specification for 62.5 micron Core Diameter/125 micron Cladding Diameter Class 1a Multimode, Graded-Index Optical Waveguide Fibers
- TIA/EIA-568; Commercial Building Telecommunications Wiring Standard
- TIA/EIA-569; Commercial Building Standard for Telecommunications Pathway and Spaces
- TIA/EIA-570; Residential Telecommunications Cabling Standard
- TIA/EIA-606; Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- J-STD-607; Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- TIA/EIA-758; Customer-Owned Outside Plant Telecommunications Cabling Standard
- TIA/EIA TSB3; Additional Cable Specifications for Unshielded Twisted Pair Cables

10.21.1 Government Documents

- UFC-3-580-01; Telecommunications Building Cabling Systems Planning and Design
- AF Technical Order 31-10-34; Engineering and Installation: Fiber Optic Communication Cables and Connectors

10.21.2 Military Specification (MS)

- MIL-F-15733G; Filters and Capacitors, Radio Frequency Interference, General Specifications
- MIL-F-18327F; Filters, High Pass, Low Pass, Band Pass, Band Suppression, and Dual Functioning

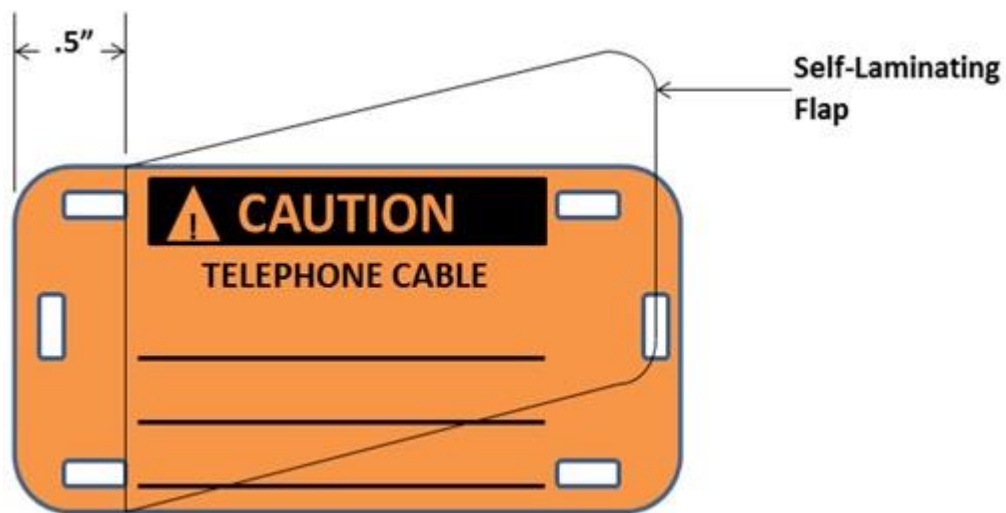
10.21.3 Military Standard (MIL-STD)

- MIL-HDBK-419A; Grounding, Bonding, and Shielding For Electronic Equipment and Facilities Volume I and II
- MIL-STD 188-124B; Grounding, Bonding, and Shielding For Common Long Haul/Tactical Communications Systems

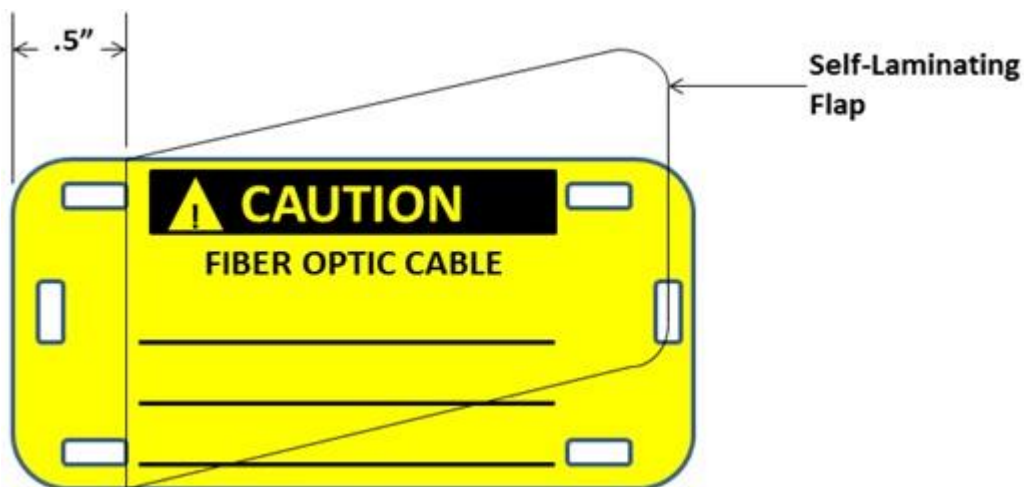
Annex 1

88th Communications Group
Labeling Requirements
For
Communications

1. Introduction. This document provides guidance on labeling of communications cabling, racks, and connections. All new installations and upgrades to communications equipment/systems will label cables, racks, and equipment per this document. Any questions on this document or on labeling communications cables/systems are to be directed to 88 CG/SCX.
2. General guidance. All labels shall be machine printed or stencils. Hand written labels will not be used. All labels will be securely affixed to racks, equipment, or cables.
3. Label types. Use the following type self-laminating cable labels for copper and fiber optic cables used in the backbone (building-to-building, between CERs, etc.). All information shall be done on printer labels. They will then be placed on the tag and the self-laminating flap sealed down on it. The printing shall be as large as possible for easy readability. Secure the tags to the cables with a tie wrap at each end.

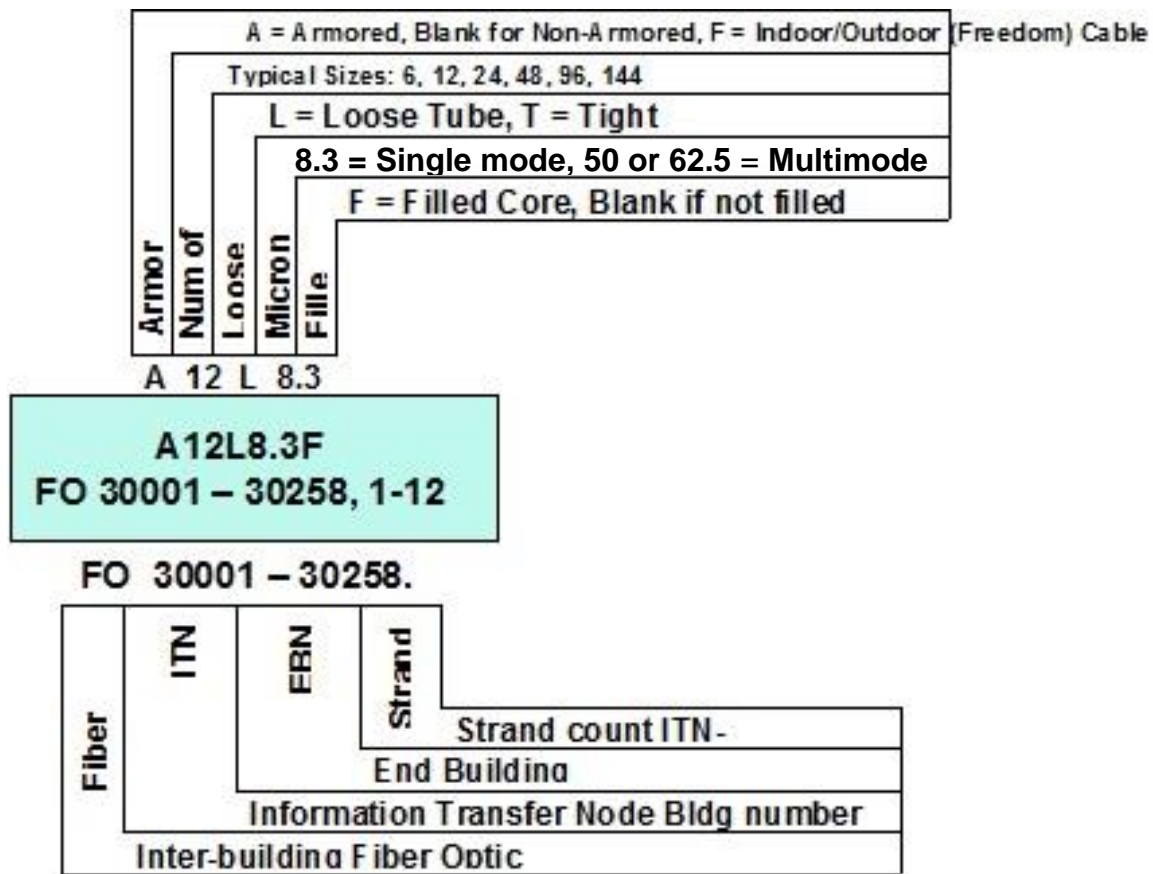


Copper Cables

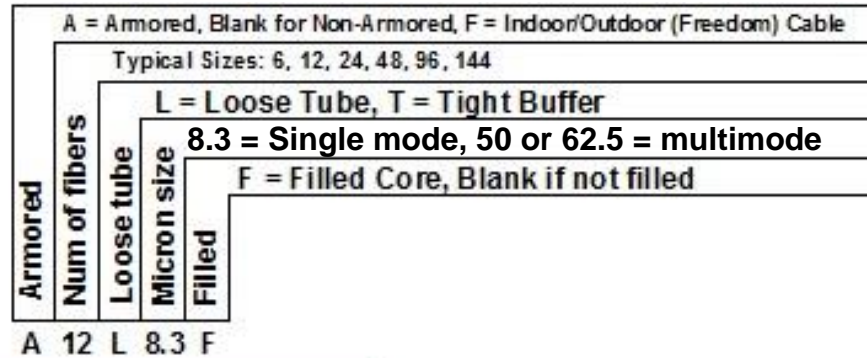


Fiber Optic Cables

4. Fiber optic cable numbers.
- A. Inter-buildings (building-to-building) cables.
- 1) Single mode cable.

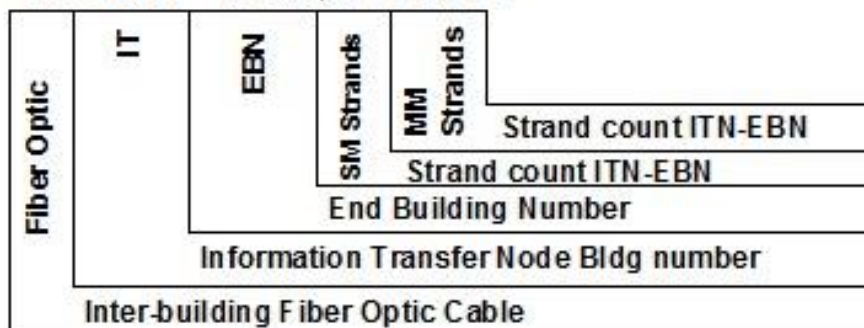


2) Composite cable.



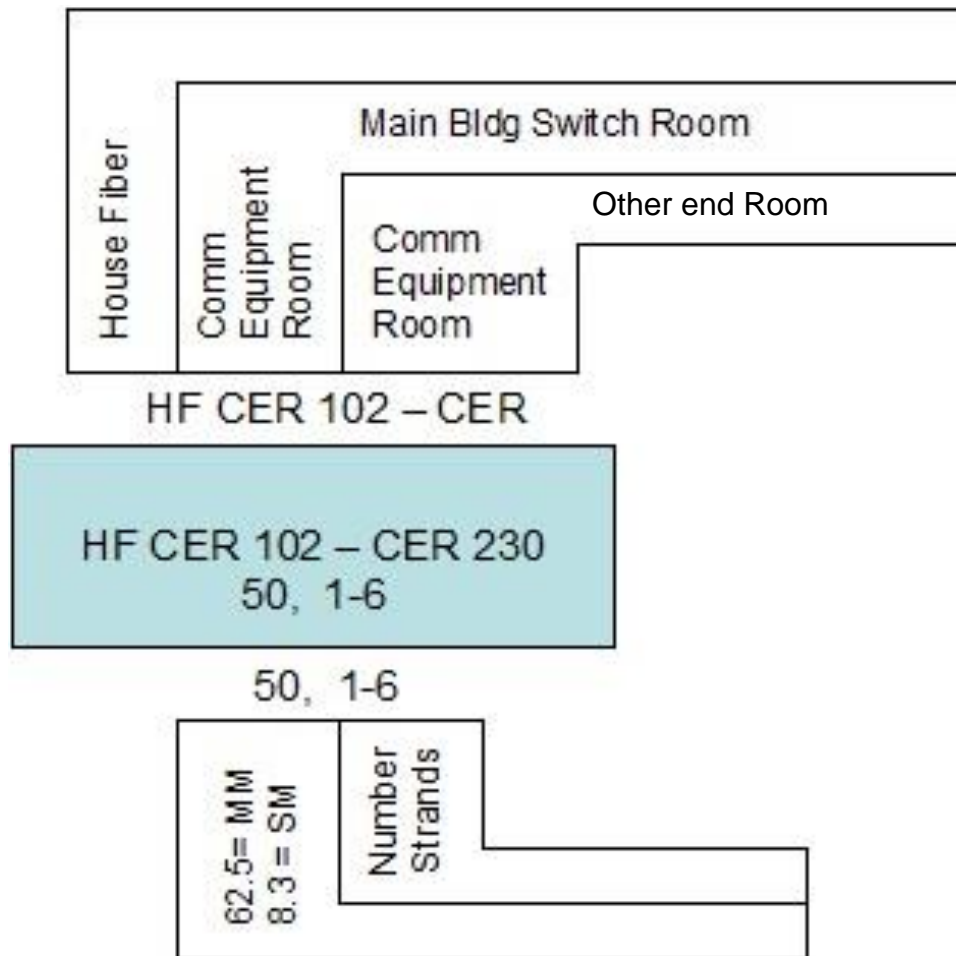
A 12L8.3/50F
FO 30001 – 30258, 1-12/13-24

FO 30001 – 30258, 1-12/13-24

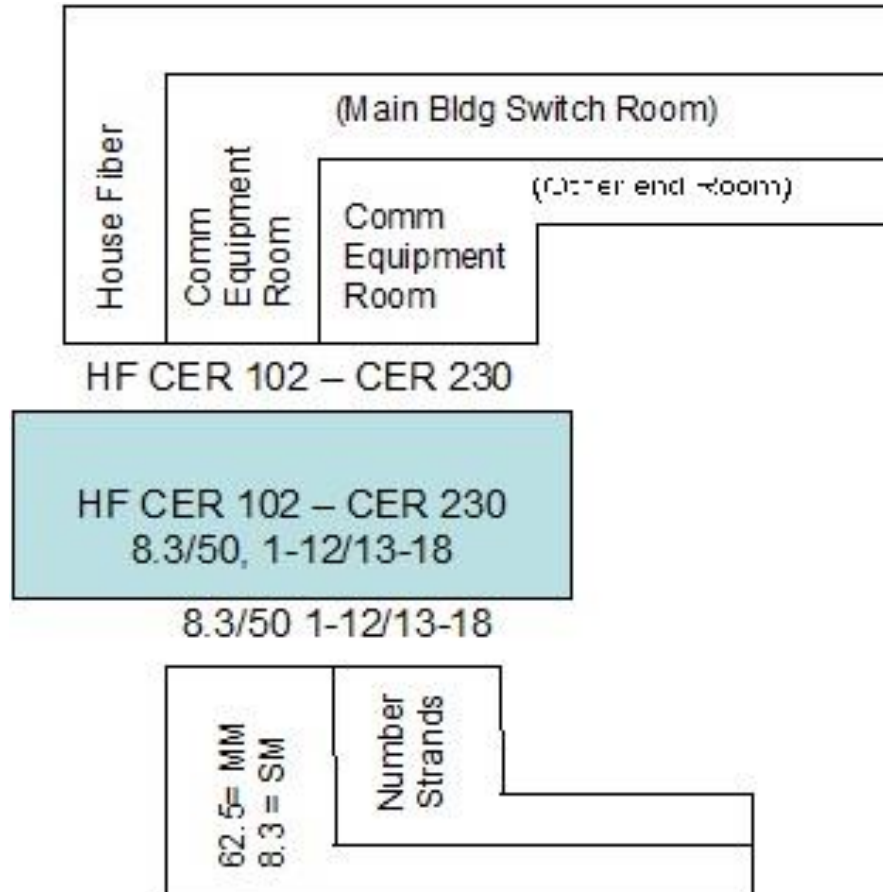


A = Armored, Blank for Non-Armored, F = Indoor/Outdoor (Freedom) Cable

- B. Intra-building (within a building) cables.
1) Multimode fiber.



2) Composite fiber.

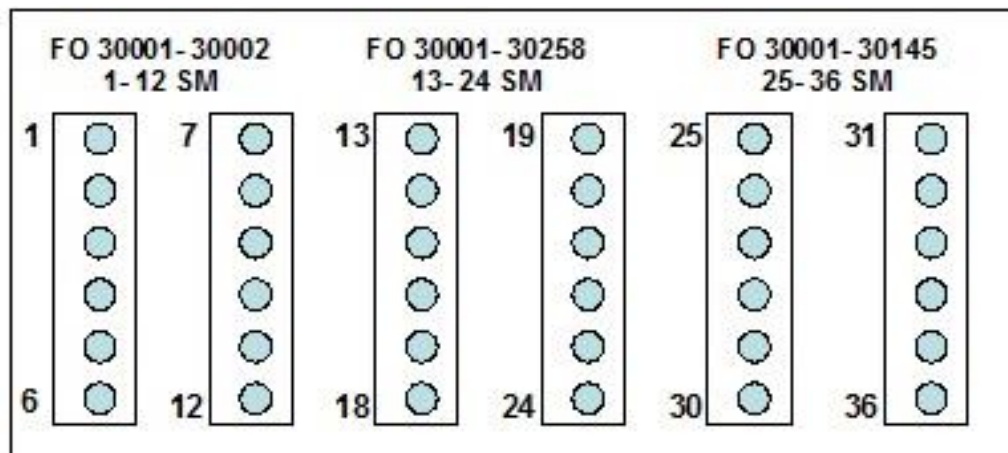


5. Copper cable numbers.

P1-24PF = Plastic/100pr/24 gauge/filled			
Insul Type	# Pairs	Gauge	Core
P = Plastic	6X = 6 pr	19	P = Air Core PF = Filled
	12X = 12 pr	22	
	25 = 25 pr	24	
	50 = 50 pr	26	
	1 = 100 pr		
	2 = 200 pr		
	3 = 300 pr		
	4 = 400 pr		
	6 = 600 pr		
	9 = 900 pr		
	12 = 1200 pr		
	15 = 1500 pr		
	18 = 1800 pr		
	21 = 2100 pr		
	24 = 2400 pr		
	36 = 3600 pr		

6. Fiber Optic Distribution Panel (FODP) numbers.

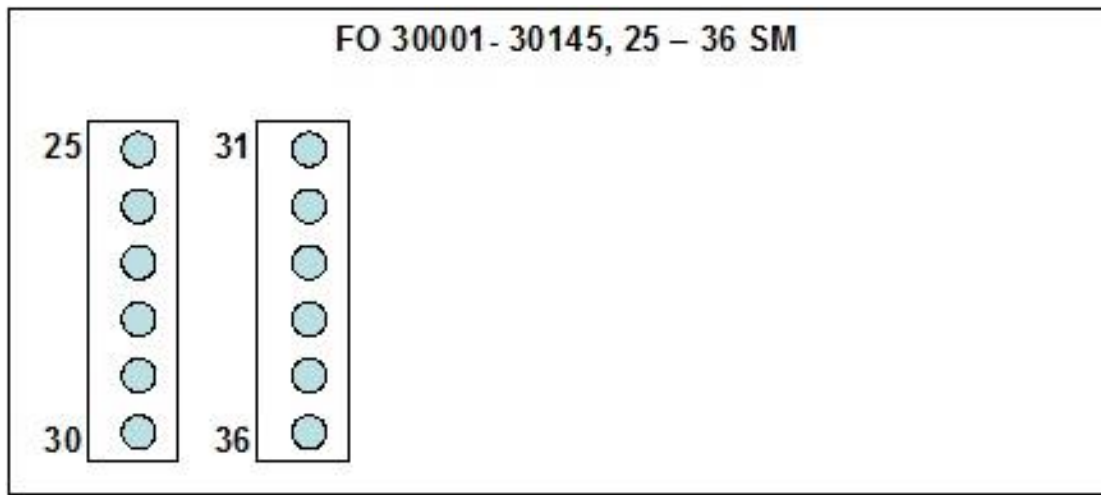
A. FODP in ITN with cable spliced and going to multiple buildings.



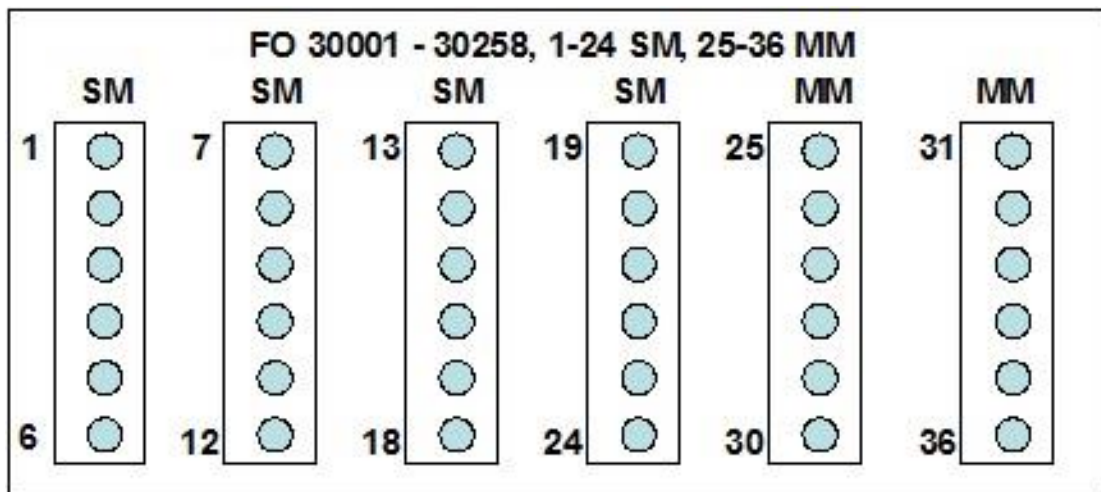
When a large fiber cable goes from an ITN and is spliced to smaller cables going to an end building mark FODP as above. **(FO)** stands for fiber optic, the first number is the ITN number (**30001**), the second number is the end building number (**30002, 30258**), the strand counts. When all strands are not spliced through to an end building, mark that count ITN number to dark and MH where they end (**dark MH 352**). Mark the bulkhead connectors as indicated.

B. FODP for single cable at end building.

1) Spliced cable at end building.



2) Composite cable at ITN or end building.



7. Network jack labels/numbers.

- A. Network jacks shall be labeled and color coded as to the type of traffic they handle. The tables below show required colors and jack types for new installations. These jack types should be used unless the equipment that is being connected to these jacks requires a different type.

1) Panduit keyed LC fiber connectors.

Unclassified						
Type	Cable color	Wall Conn type	CER Conn type	Wall Jack color	Patch cord color	Device cable color
Copper Cable for Voice	Blue	RJ45	RJ45	Blue	White	N/A
Copper Cable for Data	Blue	RJ45	RJ45	Blue	Blue	Blue
KAS Cable	Blue	RJ45	RJ45	Orange	Orange	Orange
AFRL Enclave	Blue	RJ45	RJ45	Pink	Pink	Pink
Single Mode Fiber Optic Cable	Yellow	LC	LC	Yellow	Yellow	N/A
Multi Mode Fiber Optic Cable	Orange	LC	LC	Orange	Orange	N/A
50 Micron Fiber Optic Cable	Aqua	LC	LC	Aqua	Aqua	N/A
Classified						
Type	Cable color	Wall Conn type	CER Conn type	Jack color	Patch cord color	Device cable color
Copper Cable for Voice	Blue	RJ45	110 Block	Blue	White	N/A
Multi Mode Fiber Optic Cable for an Unclassified Network private within organization and NIPRNET	Green	Keyed LC	LC	Green	Green	Green
Multi Mode Fiber Optic Cable for a Confidential Network	Blue	Keyed LC	LC	Blue	Blue	Blue
Multi Mode Fiber Optic Cable for a Secret Network Private within organization and SIPRNET	Red	Keyed LC	LC	Red	Red	Red
Multi Mode Fiber Optic Cable for a Top Secret Network Private within organization and JWICS	Yellow	Keyed LC	LC	Yellow	Yellow	Yellow
Special Access Required systems	Orange	Keyed LC	LC	Orange	Orange	Orange
NOTE 1: Panduit Keyed LC connectors shall be used						
NOTE 2: The connector used for the PC end of the device cable will match the NIC on the user's PC, usually SC or ST.						

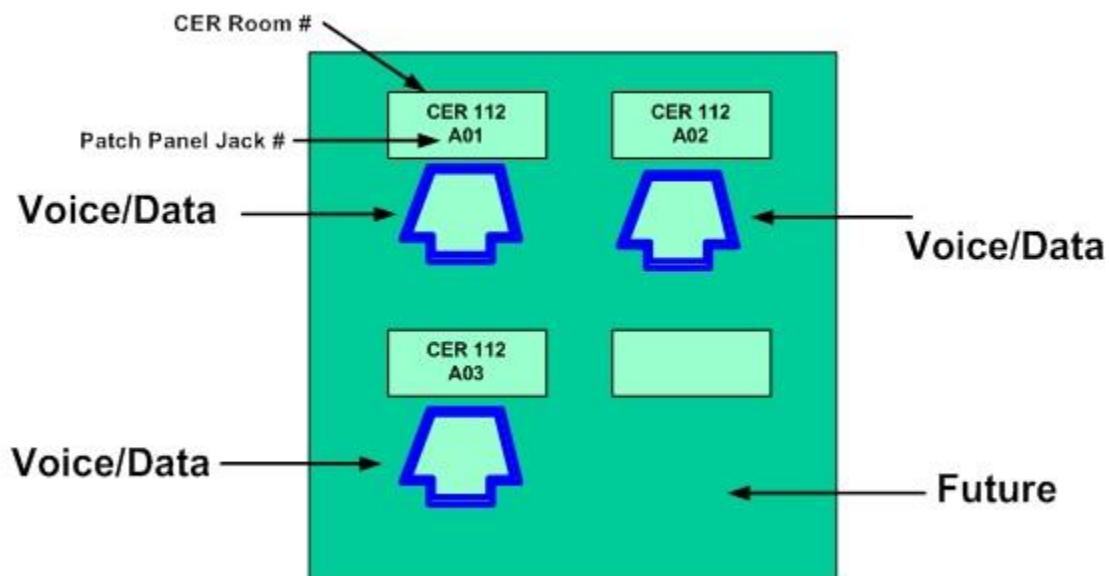
2) Multi-type fiber connectors for existing facilities.

Unclassified			
Type	Cable Color	Connector Type	Jack Color
Copper Cable for Voice	White	RJ45	White
Copper Cable for Data	Blue	RJ45	Blue
Single Mode Fiber Optic Cable	Yellow	MTRJ	Yellow
Multi Mode Fiber Optic Cable	Orange	MTRJ	Orange

Classified			
Type	Cable Color	Connector Type	Jack Color
Copper Cable for Voice	White	RJ45	White
Multi Mode Fiber Optic Cable for an Unclassified Network private within organization and NIPRNET	Green	LC	Green
Multi Mode Fiber Optic Cable for a Secret Network Private within organization and SIPRNET	Red	ST	Red
Multi Mode Fiber Optic Cable for a Top Secret Network Private within organization and JWICS	Yellow	SC	Yellow

B. Jacks should be labeled to identify type network and communications equipment room (CER) they run to as follows:

- 1) Copper. Jacks shall be marked with the communications equipment room (CER) where the other end is located and the jack number.



2) New facility keyed LC fiber jacks.

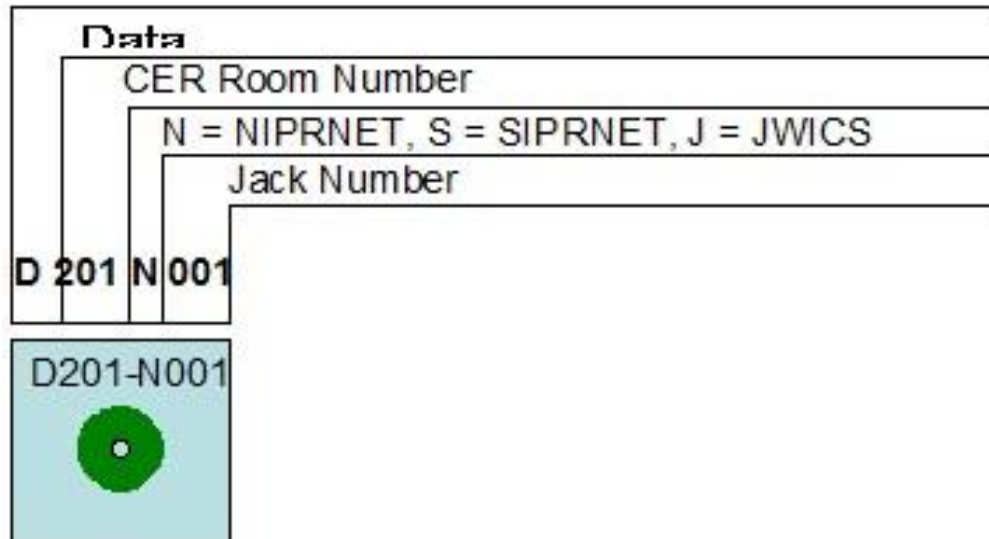


3) Existing multi-type fiber jacks.

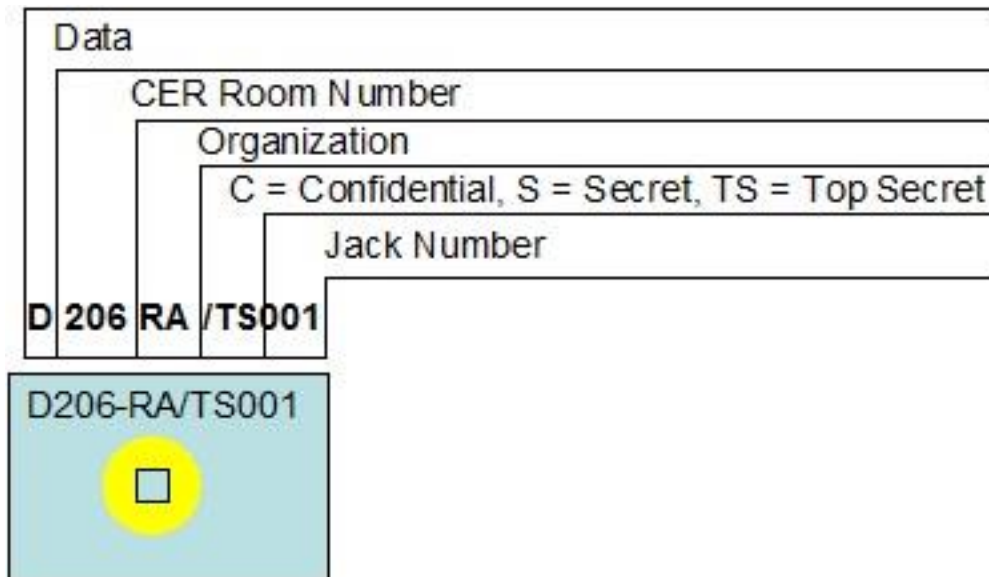


- 4) The color of the jack denotes the classification, based on the table above. Different type connectors will also be used for each different classification of information to prevent mixing system access. The jacks are shown below:

- a) Standard NIPRNET, SIPRNET, JWICS jacks.

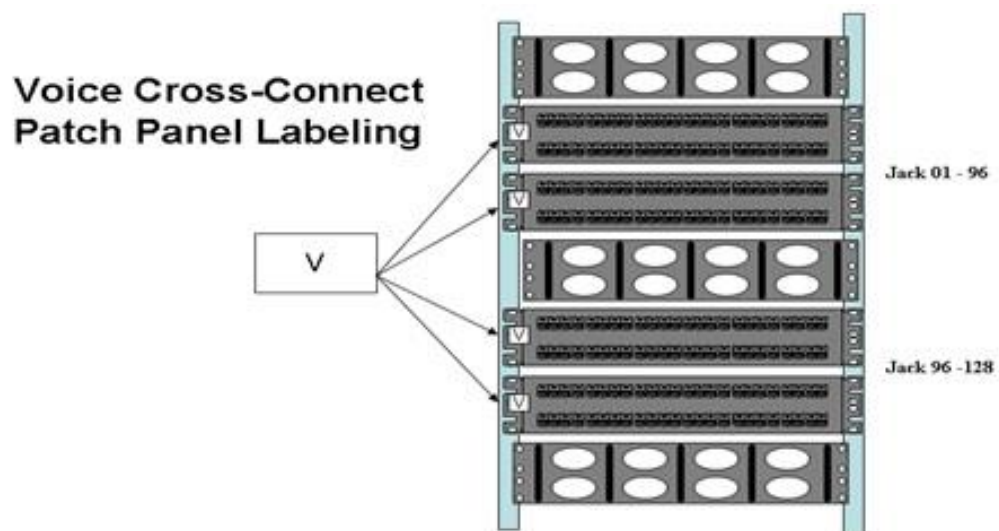
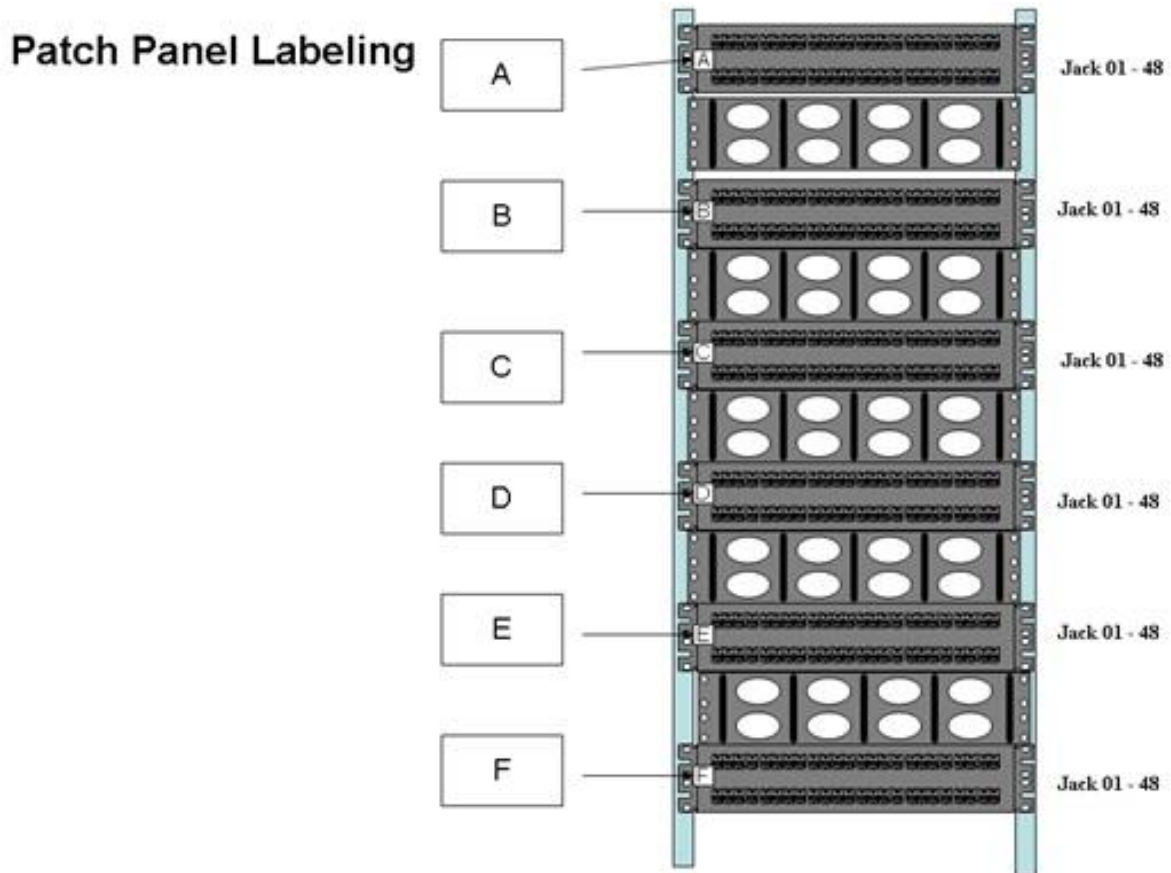


- b) Jacks for private networks.



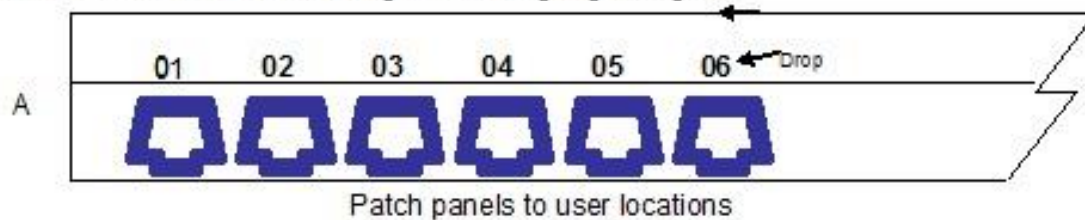
8. Patch panel labels/numbers.

- A. Patch panels should be labeled as shown below. Each patch panel going to user locations shall be labeled A-U starting from top to bottom. Each jack should be labeled in sequence from 01 through 48. The patch panels going to the 110 blocks mounted on the wall will all be labeled V and numbered 01-XXX

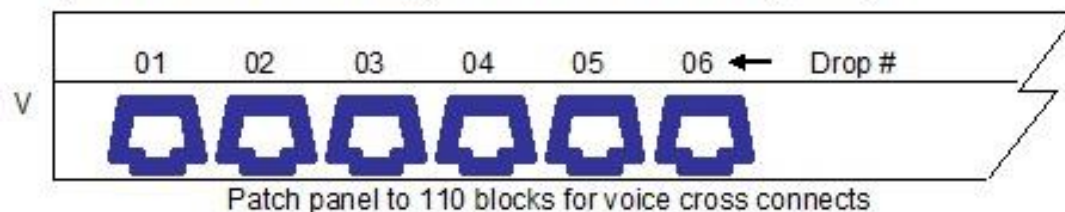


B. Patch panel jack labels.

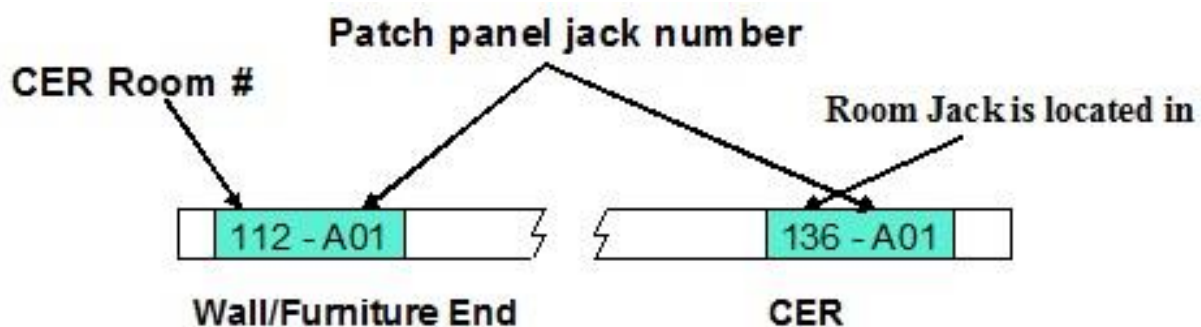
A = (Letter for Patch Panel starting with A and going through U)



V = (Letter for Patch Panel and the jacks will be numbers 01 through XXX)



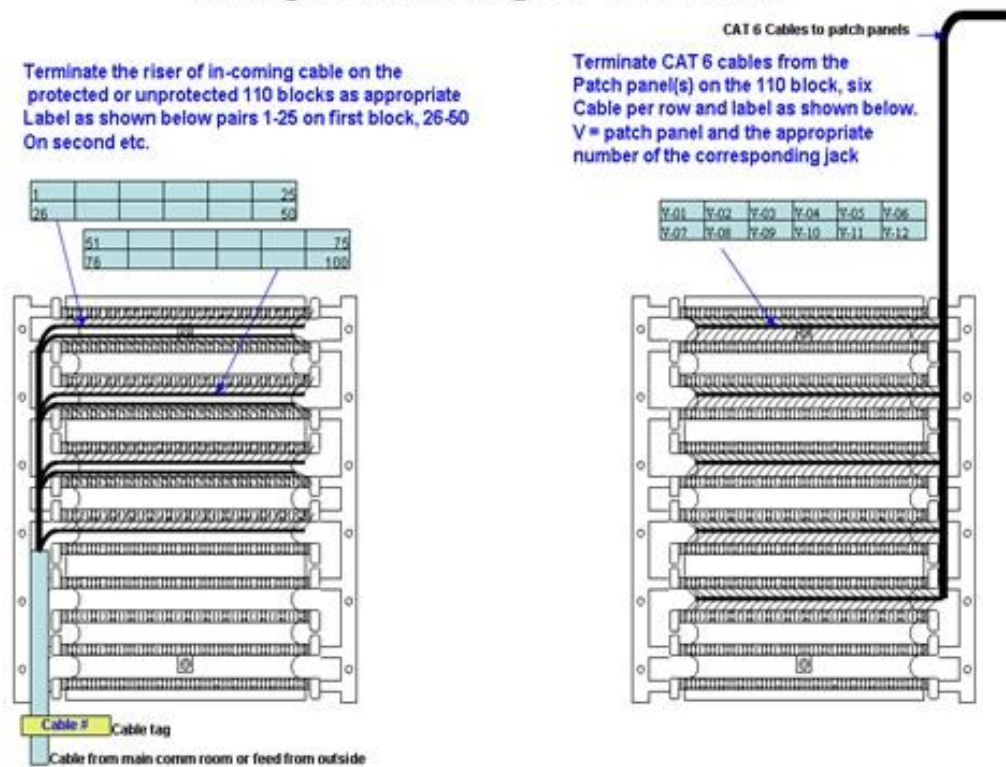
- C. Cable labels. Data copper cables shall be labeled as shown below. At the wall jack location label the cable with the CER room number and patch panel jack number. At the patch panel end label the cable with the room number where the wall jack is located and the patch panel number.



9. Punch down block labels/numbers.

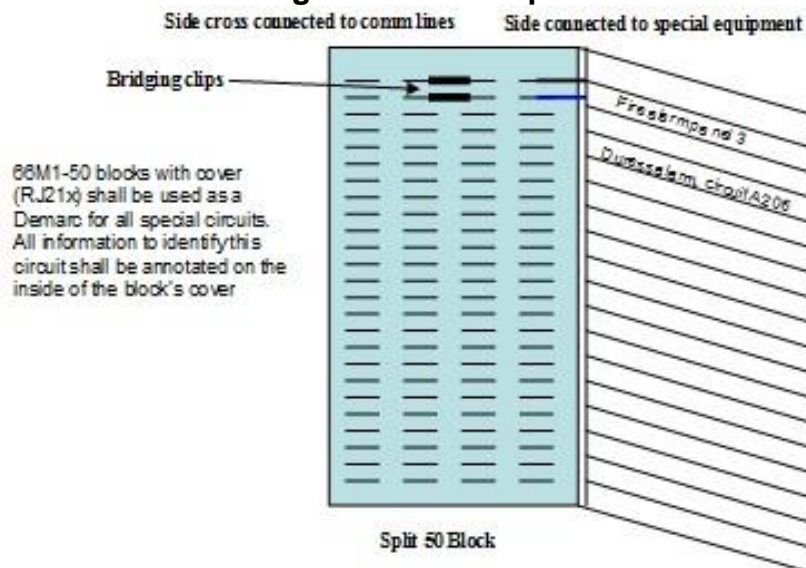
- A. Label the 110 block where the copper cable that feeds the building and the copper riser cables with the pair numbers as shown on the below drawing. Label the 110 blocks that have the latest TIA approved category cables terminated on them to the patch panels for cross connecting the voice circuits with the letter V and the patch jack number, as indicated below:

Wiring and Labeling for 110 Blocks

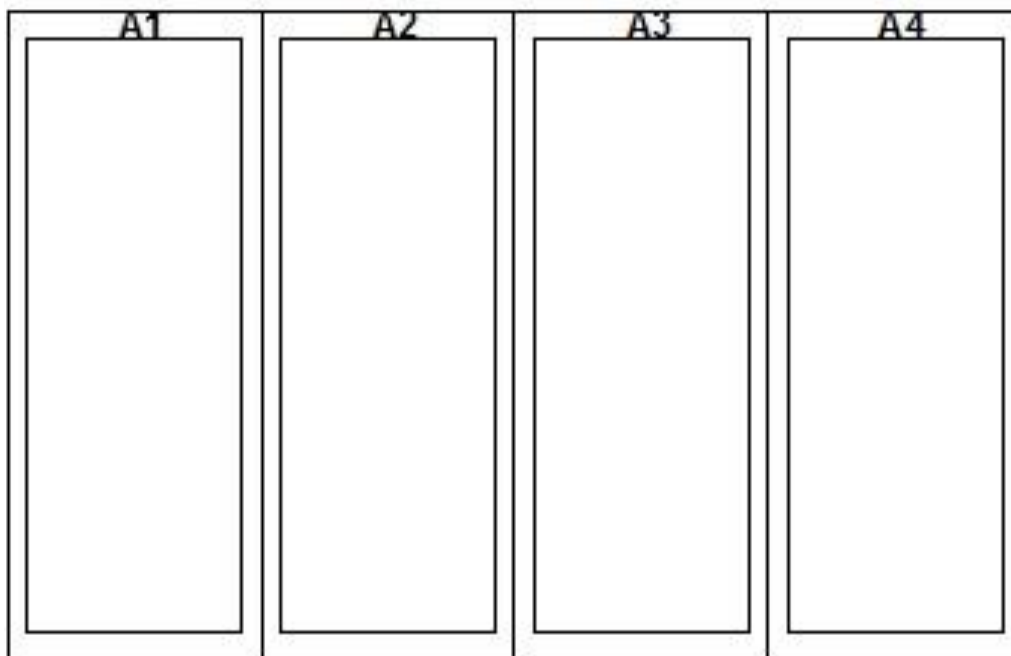
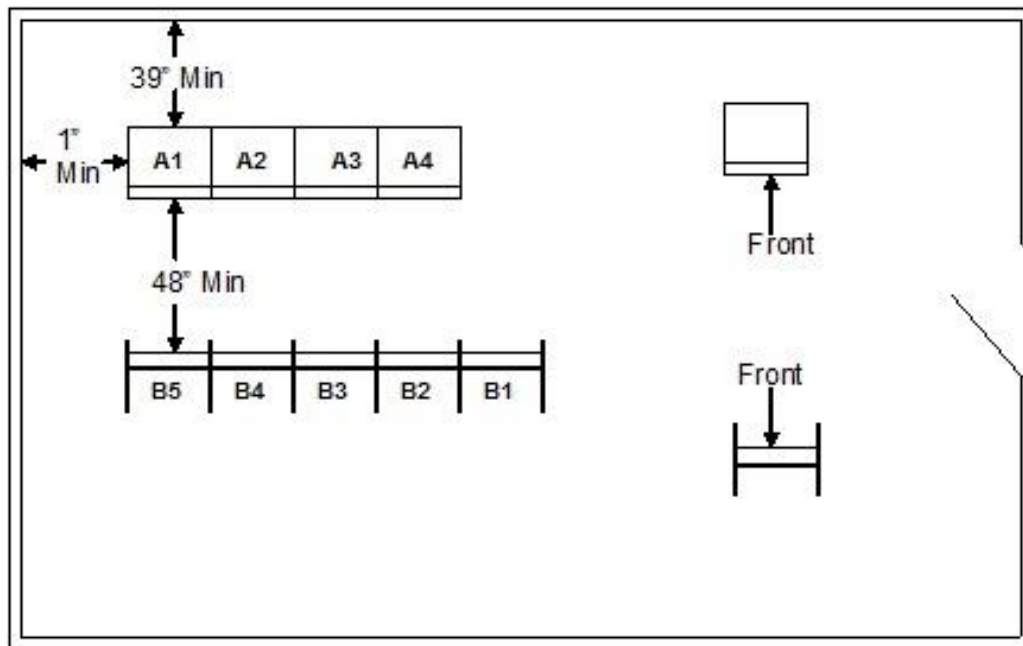


- B. 66M1-50 (RJ21X) Blocks for special circuits. These blocks shall have covers and the labeling will be annotated on the inside of the cover in the appropriate location. Include all available information, i.e. circuit numbers, type circuit (fire alarm, security alarm, etc.)

Labeling 66M1-50 for Special Circuits



10. Communications equipment rack/cabinet labels/numbers. All racks need to be identified with a Floor Plan Identification number. They should have the rack number affixed to the top of the rack. The label should be a printed decal or other large size marking. When the communications room contains more than one rack or cabinet they need to be numbered from left to right looking at the front of the racks. If the communications room contains multiple rows of equipment the row can be identified as A, B, C, etc and numbered A1 – Ax, B1-Bx starting from the left looking at the front of each row. All floor plan drawing will also have the racks numbered for ease of identification. See examples:



APPENDIX A: WPAFB CADD STANDARDS

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100 CADD STANDARDS

101 General

All design work to be provided under this contract shall be accomplished and developed using Computer Aided Drafting and Design (CADD) software and procedures conforming to the criteria developed in the Base Facility Standards (BFS) in conjunction with the United States National CAD Standards (NCS).

The target CADD software is AutoDesk, Inc. AutoCAD 2012 utilizing the DWG file format.

102 Graphic Format

All CADD data shall be supplied in AutoDesk, Inc. AutoCAD 2012 utilizing the DWG file format or AutoDesk, Inc. Revit 2012 utilizing the RVT file format. The contractor shall ensure that all digital files and data sets are compatible with the Government's target CADD system and adhere to the standards and requirements specified herein. The term **compatible** means that data can be accessed directly by the target CADD system without translation, preprocessing, or post processing of the electronic files. It is the responsibility of the contractor to ensure this level of compatibility.

103 CADD Standards

103.01 Co-Ordinate System & Datum

All elevations are orthometric heights using the North American Vertical Datum of 1988 (NAVD 88) and the GEOID09 geoid. Horizontal positions are based on the Ohio State Plane Coordinate System (OSPCS), South Zone, a Lambert conformal conic map projection, the North American Datum of 1983 adjusted to the National Spatial Reference System of 2007 [NAD 83(NSRS 2007)], and the GRS80 ellipsoid.

103.02 Fonts & Text

All text shall be one of the dark primary colors (i.e., black, red, or blue).

The preferred fonts to be used are the Microsoft Office True Type (TT) fonts.

The minimum text size shall be 0.14 inches utilizing a line spacing of one-half the text height except for paragraphs of text such as general notes that shall use line spacing equal to the text height. This is to insure that half size plans are readable.

103.03 Government Furnished Materials (GFM)

Sheet borders and etc. shall be supplied to the contractor.

103.04 Plan Production

The standard printed sheet size shall be 34" x 22" (ANSI D) for full size, and 17" x 11" (ANSI B) for half size plans.

Each sheet shall have a unique sequential sheet number and a number showing the total number of sheets in the plan set (i.e., 12 of 50, 35 of 50). Also shown shall be a drawing reference number consisting of a discipline designator and a three-digit number (C101, A201, P001 – must include leading zeroes).

The drawing reference number shall also be used in the sheet naming schema. The DWG file shall utilize the same sheet reference number with the file extension being the only difference in each sheet's file name (i.e., C101.dwg and C101.pdf, P001.dwg and P001.pdf, etc.). There shall be only one sheet per DWG file.

Discipline Designator			
A	Architectural	M	Mechanical
B	Geotechnical	O	Operations
C	Civil	P	Plumbing
D	Process	Q	Equipment
E	Electrical	R	Resource
	Fire		
F	Protection	S	Structural
G	General	T	Telecommunications
	Hazardous		
H	Materials	V	Survey / Mapping
I	Interiors	X	Other Disciplines
			Contractor / Shop
L	Landscape	Z	Drawings

The contractor shall only use the sheet border files supplied. The sheet border files have the trim line established on layer Trim Area. Layer Trim Area is reserved and shall not be used to place any other features.

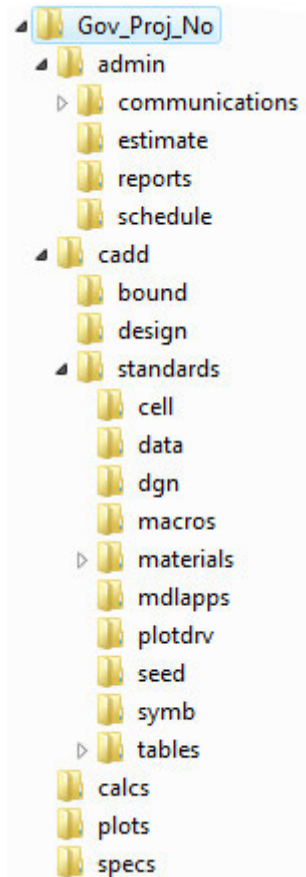
103.05 Other Project Documents

Other construction documents such as design analysis, engineering calculations, cost estimate and miscellaneous information shall be submitted in Microsoft Office or PDF format. In addition to the electronic data, multiple hard copies of the design submittal items shall be required; the exact number of hard copies shall be identified in each individual A/E task order.

See the BFS Section 2.4 Specifications for submittal requirements for construction specifications.

103.06 Directory Structure

The directory structure below shall be used for all electronic submittals. The Contractor may elect to use their own directory structure on their server, but all submittals to WPAFB shall utilize the structure noted. The Consultant may provide additional subdirectories if needed.



Reference files shall use **relative pathing**. Hard coding or using configuration variables to define the path for references is not permitted.

103.07 Deviation from Standards

The Contractor shall submit a written request for approval of any deviations from the Government's established CADD standard. No deviations from the Government's established CADD standard shall be permitted unless prior written approval of such deviation has been received from the Government.

104 Submittals

104.01 General

A copy of all CADD data and files developed under this contract shall be delivered to the Government on electronic digital media at the design submittal intervals (normally at the 10%, 35%, 65%, 95%, and 100% levels) as indicated in each individual A/E task order. For each submittal the contractor shall deliver the CAD design files and a single B/W Scaled Engineer PDF file representing the printed sheets of the plan set, accompanied with a transmittal letter.

104.02 Electronic Media & Format

The electronic submittal shall be submitted on a standard size CD-ROM or DVD, no exceptions.

The following information at a minimum must be labeled on the delivered electronic media:

- Government Project Number (and Delivery Order Number if applicable)
- Date Submitted
- Contractor's Name and contact information
- The sequence number of the digital media (1 of 1, 1 of 2, etc.).

104.03 Preparation for FINAL Submission

Before CADD files are delivered to the Government the following tasks shall be performed:

1. Compress all design files.
2. Design Set: provide DWG files with references, etc. intact (DO NOT merge data into files).
 - A. All reference files and other attachments shall remain intact and unmodified.
3. Bound Set: provide another set of DWG files that are standalone (merge all data into file).
 - A. Each finished file (sheet) shall be a complete standalone drawing with no reference files attached. The government shall be able to plot each file without attaching any files or modifying/changing any settings. Up to four view ports will be allowed per drawing file on the standalone version. These view ports can only be of the drawing that they are appearing on and each must be on a different level.
 - B. Remove all extraneous graphics outside the border area.
4. PDF representing the printed plan set.
 - A. These shall be flattened and compressed PDF files.

- B. Any renderings and/or special exhibits shall also be provided as PDF, JPEG, REVIT files.

The finished (100% design) submittal should match the corresponding electronic design files. In the event of a discrepancy, the hard copy (PDF) shall prevail in all disputes.

105 Drawing Development Documentation

Documentation for the FINAL (100%) delivered plan set shall be provided as per the requirements of the following sections:

- Section 103.10 Deviation from Standards.
- Section 205 Survey Reports.

106 Transmittals

A transmittal letter, addressed to the Design Manager with a copy to the Contracting Officer as indicated in each individual A/E task order, shall accompany each submittal to the Government. The transmittal letter shall be dated and signed by the appropriate Contractor's representative and formatted to fit 8-1/2" x 11" (ANSI A) paper. An electronic copy of the transmittal letter in a Microsoft Word (DOC) or Adobe Acrobat (PDF) shall also be provided on the electronic digital media submitted to the Government. The transmittal letter shall contain, as a minimum, the following information:

1. Digital media content
 - A. The information included on the outside of each disk and a list of the names and descriptions of the files on each disk.
2. Scanned for viruses
 - B. A statement including the name(s) and release date(s) of the virus-scanning software used to analyze the delivery media, the date the virus scan was performed, and the operator's name shall also be included with the certification.
 - C. The release or version date of the virus-scanning software shall be the current version which has detected the latest known viruses at the time of delivery of the digital media.
3. Records Retention
 - D. A statement indicating that the A/E shall retain a copy of all delivered electronic digital media (with all files included) for at least one year after the completion of the project.
 - E. During this period, the contractor may be required to provide the Government up to two additional copies of the electronic submittal at no additional cost.
4. Deviation from Standards

- F. List of all new symbology (line styles, patterns, fonts, cells, etc.) created for the project not provided to the Contractor with the Government Furnished Materials.
- 5. Database Files
 - G. List of all database files, associated with each drawing, as well as a description and documentation of the database format and schema design (if applicable).
- 6. Other CADD Software
 - H. If not working natively in Autodesk Inc. AutoCAD 2012, please specify the CADD software used for design.

107 CADD/GIS Facilities Mapping

107.01 Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE)

The Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE 3.0) <http://www.sdsfie.org> provides a standardized grouping of geographically referenced features or objects depicted graphically on a map at their real-world co-ordinates. Each geospatial feature has an "attached" attribute table containing pertinent data about the geospatial feature.

The SDSFIE is the only "nonproprietary" GIS data content standard designed for use with the predominant commercially available off-the-shelf GIS and CADD (e.g., ESRI ArcGIS, AutoDesk Inc. AutoCAD and Map), and relational database software (e.g., Oracle and Microsoft Access). This nonproprietary design, in conjunction with its universal coverage, has propelled the SDSFIE into the standard for GIS implementations throughout the Department of Defense (DOD), as well as the de facto standard for GIS implementations in other Federal, State, and local government organizations; public utilities; and private industry throughout the United States and the World.

The Spatial Data Standard represents an organization of data without regard to application. The assignment of specific entities to entity sets is a function of data maintenance rather than data use. In this way, it is possible to reduce redundancy of information within the standard. This schema meets data sharing requirements of the National Spatial Data Infrastructure (NSDI).

Spatial Data Standards define the nomenclature of the feature datasets, feature classes, and attribution of all features stored within the geodatabase. This standardization allows the data and custom applications, which interface directly with datasets, to be easily shared among other districts or with those agencies using Spatial Data Standards. Software is available for download at <http://www.sdsfie.org>.

107.02 Contractor Requirements

Until the notice has been issued the Contractor shall supply to the Government, either on the drawings in the DWG file or in tabular form utilizing Microsoft Office compatible applications, all non-graphical information about the different material used in the project design. Examples of the type of non-graphical information needed are, but not limited to: pipe size, material and slope, top, bottom and inverts of all pipes in manholes, etc. Tops of new water valve stems and the top of the cover, the manufacture's name of new equipment and model number, tonnage, motor information, if existing utility lines are to be abandoned and all standard information that may be needed to replace a piece of equipment or infrastructure if it were to fail.

The Contractor shall do the following:

1. The matchlines of all digital maps must exactly match those adjoining them.
2. The digital representation of the common boundaries for all graphic features must be exactly the same. Each feature within a map theme must be represented by a single graphic element (e.g., polygon or line/string).
3. Lines/strings which represent the same graphic element must be continuous (i.e., not broken or segmented), unless that segmentation reflects a specific visual line style.
4. Polygons must be closed and have a single unique centroid to which attributes can be attached. Polygons of the same coverage must not overlap and must cover the area of interest completely.
5. All graphic elements that connect must exactly connect digitally without overlaps or gaps.
6. Straight lines must be represented by only the beginning and ending X and Y co-ordinate points. Lines/strings must not cross back on themselves or be of zero length.
7. Internet sources of detailed information concerning the content and format for the metadata files can be obtained from the following URL addresses:
 - Federal Geographic Data Committee: <http://www.fgdc.gov/>
 - Geospatial One Stop: <http://www.geo.data.gov/>
 - U.S. Army Corp of Engineers, Maps:
<http://www.usace.army.mil/Library/Maps/Pages/home.aspx>
 - NCS: <http://www.nationalcadstandard.org/ncs5/about.php>

108 Ownership

The Government, for itself and such others as it deems appropriate, shall have unlimited rights under this contract to all information and materials developed under this contract and furnished to the Government and documentation thereof, reports, and listings, and all other items pertaining to the work and services pursuant to this agreement including any copyright. Unlimited rights under this contract are rights to use, duplicate, or disclose text, data, drawings,

and information, in whole or in part in any manner and for any purpose whatsoever without compensation to or approval from the Contractor. The Government shall at all reasonable times have the right to inspect the work and shall have access to and the right to make copies of the above mentioned items. All text, electronic digital files, data, and other products generated under this contract shall become the property of the Government.

200 SURVEYING

201 General

The contractor, operating as an independent contractor and not an agent of the Government, shall provide all labor, material, and equipment necessary to perform the services as stated in this contract. The contractor shall furnish the required personnel, equipment, instruments, and transportation, as necessary to accomplish the required services and furnish to the Government all reports and other data together with supporting material developed during the work efforts.

During the prosecution of the work, the contractor shall provide adequate professional supervision and quality control to assure the accuracy, quality, completeness, and progress of the work.

202 Location of Services

All surveying performed under this contract may be required anywhere within the boundaries or assignments of WPAFB.

203 Services to be Performed

The general types of professional surveying, mapping, GIS, and related services to be performed under this contract include, but are not limited to, the items listed below.

203.01 Geodetic Control Surveys

Services include horizontal and vertical control surveys for the precise location of primary survey points for planning, engineering, construction, real estate projects, GIS applications, or facility management. These surveys include third order or higher horizontal and vertical control, geodetic astronomy, gravity, and magnetic surveys in accordance with the Standards and Specifications for Geodetic Control Networks published by the Federal Geodetic Control Committee dated September 1984. Conventional, inertial, satellite, and other traditional precise survey methods as determined to be the most cost-effective means that shall achieve the required accuracy of the final product may be used. For technical specifications and procedural guidance the U.S. Army Corps of Engineers Geodetic and Control Surveying Manual EM 1110-1-1004 is to be used.

203.02 Boundary and Cadastral Surveys

These services consist of, but are not limited to, locating, relocating, and/or marking Government boundaries, easements, etc. and preparing or filing/recording certified drawings, computations, deeds, and related descriptive data in accordance with local,

state, and Federal requirements, regulations, and laws. Services shall also include all such deed and other research necessary to perform said services.

203.03 Topographic and Engineering Surveys

Services include but are not limited to field acquisition and office data reduction of detailed topographic and planimetric feature data for use in engineering site planning, cost estimating, design, construction layout and alignment of roads, buildings, and other structures, installation master planning, and recording as-built conditions and GIS applications. Field data acquisition includes both conventional and other methods, such as a plane table, total station, or GPS. For surveys utilizing GPS the U.S. Army Corps of Engineers Navstar Global Positioning Systems Surveying Manual EM 1110-1-1003 is to be used. And the U.S. Army Corps of Engineers Topographic Surveying Manual EM 1110-1-1005 is to be used for topographical surveys.

203.04 Photogrammetric Services

Services include but are not limited to the acquisition of aerial photographs, both hard copy and digital, and the compilation of data necessary to generate surveying, mapping, and GIS spatial data products.

203.05 Conventional, Digital Mapping and Charting Services

Services include the development, implementation, acquisition, and/or generation of conventional and/or digital mapping and charting products. Services include, but are not limited to, two-dimensional and three-dimensional mapping and charting, digital terrain models, soft-copy photogrammetry, and GIS products.

203.06 Geographic Information System (GIS) Services

Services include, but are not limited to, the development and implementation of a GIS (hardware, software, data, personnel, approach, procedures, training, etc.) and the production of GIS products (maps, databases, etc.). A GIS consists of an automated computerized system that employs data referenced to a location on the earth, based upon absolute, relative, or assumed coordinates. The target GIS includes the following basic components, which are currently installed, or are to be installed, at the organization, which shall be receiving and using the geospatial data:

- Computer platform (computer hardware and operating system).
- GIS software.
- Relational Database Management System (RDBMS) software, database schema, and data.
- Digital media containing the organization's graphic and attribute geospatial data.

The digital media are formatted to conform to the organization's GIS standard, and installed to function as an integral part of the GIS. The database of the GIS is "populated" with attribute data. All GIS data (including geospatial data acquisition and map development for use in a GIS) shall conform to the most current release of the Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE) <http://www.sdsfie.org>. All delivered digital GIS data files shall also be submitted in strict compliance with the SDSFIE for the target GIS system.

203.07 Remote Sensing

Remote sensing is the stand-off collection through the use of a variety of devices for gathering information on a given object or area. Services include satellite imagery, film imagery, side-scan sonar, magnetometer, multi-spectral, SLAR, etc.

204 Mapping and GIS Standards

All mapping and GIS work performed as part of this contract shall conform to the following standards for accuracy, content, and structure: All large-scale mapping projects (scales larger than 1 inch = 1,667 feet), shall follow the Government Standards (Army, Navy, Air Force) and/or "ASPRS Accuracy Standards for Large Scale Maps" (ASPRS 1990) classification standard. Small-scale mapping (scales smaller than 1:24,000) projects shall follow the OMB "United States National Map Accuracy Standards" (Bureau of the Budget 1947). All spatial data generated as part of this contract shall conform to the most current release of the Tri-Service Spatial Data Standards (TSSDS). The contractor shall submit a written request for approval of any deviations from the Government's established standards. No deviations from the Government's established standards shall be permitted unless prior written approval of such deviation has been issued by the Government Contracting Officer.

- ASPRS Accuracy Standards for Large Scale Maps:
http://www.asprs.org/a/society/committees/standards/1990_jul_1068-1070.pdf
- United States National Map Accuracy Standards:
<http://nationalmap.gov/standards/pdf/NMAS647.PDF>

Prior to releasing the scope of work to the contractor, the document shall pass through the hands of the installation GIS Coordinator. The Coordinator shall review the geospatial requirements of the contract to ensure that all data being delivered to the installation is in an enterprise GIS compliant format.

205 Survey Report

Survey reports in PDF format shall be generated for each project and contain the following information:

- Cover sheet containing the Government project number, project title and the name and complete contact information of the contractor.
- Signature and seal of the Professional Surveyor overseeing the work.
- Complete explanation of the survey process.
- All calculations and assumptions.
- Survey control, co-ordinate system and datum.
- Spreadsheet of the points, pre and post correction.
- Field instrument(s) used (name, model, serial number, etc.)
- Copy of the field book notebook or digital field book.

If any survey work is done on the project whether but not limited to: GPS, total stations or any type of instrument used to turn angles and shoot distances, EDM's or a level shall supply what the horizontal coordinates are based on, the amount of time used in occupation of a point with a GPS unit to determine XYZ coordinates, type of equipment used, whether DGPS was used and what monuments were occupied by the base station and the computed accuracies of all this information. This can be turned in either on a drawing or in standard surveying reports from surveying software or tabular form.

300 ABBREVIATIONS/GLOSSARY

ACSM	American Congress on Surveying and Mapping
A/E	Architectural/Engineering firm. For the purposes of this document, the term A/E also refers to consulting firms composed of licensed surveyors and other professionals involved in the acquisition of Geospatial Data Systems (GDS) data and in the development of GDS.
AEC	Architectural, Engineering, and Construction
ALTA	American Land Title Association
AM	Automated Mapping
AM/FM	Automated mapping/facilities management
AML	Automated macro language
ANSI	American National Standards Institute Application Software designed to meet software specific needs and perform specific tasks, unlike system software, which runs other software.
ArcGIS	GIS software program developed by Environmental Systems Research Institute, Inc. (ESRI), registered and trademarked by ESRI.
ASCE	American Society of Civil Engineers
ASPRS	American Society for Photogrammetry and Remote Sensing
Attribute	Descriptive or characteristic information concerning a particular graphical object or entity.
AutoCAD	A CADD software program, developed by Autodesk, Inc. registered and trademarked by Autodesk, Inc.
Bit-mapped	A digital image made up of pixels (on-screen dots).
CADD	Computer Aided Drafting and Design
CBD	Commerce Business Daily
CD-ROM	Compact Disk, Read-Only Memory. A form of data storage, that uses laser optics rather than magnetic means for reading data.
Cell/block	An association of elements that can be stored and placed as a group and then manipulated as a group of individual elements.
CGTC	CADD/GIS Technology Center
CONUS	Continental United States
COR	Contracting Officer's Representative
CORS	Continuously Operating Reference Stations
CPU	A Central Processing Unit refers to the computer's main processing chip, or "brain" of the machine.
Crosshatch	A specific configuration of hatch lines used to aid in delineating graphical features.
Data	The components of products, Information, and the products themselves.
Database	A collection of information organized for easy retrieval. Databases are organized into a hierarchy of files having a predetermined structure and organization that can be communicated, interpreted, or processed by a specific program.

DBMS	Database Management System
DEM	Digital Elevation Model
DFAR	Defense Federal Acquisition Regulation
DFX	Drawing Exchange Format
DGPS	Digital Global Positioning System
Directory	A file that contains the names of other files.
Diskette	Also called floppy diskette. A flat piece of flexible plastic covered with a magnetic coating, which is used to store digital data. Current sizes are 5.25 in. and 3.5 in.
DMA	Defense Mapping Agency
DOD	Department of Defense
DTM	Digital Terrain Model
EC	USACE Engineer Circular
EM	USACE Engineer Manual
EO	Executive Order
ER	USACE Engineer Regulation
FAR	Federal Acquisition Regulation
FedBizOpps	Federal Business Opportunities
FGDC	Federal Geographic Data Committee
File	A group of related information.
File format	A defined digital organization and arrangement which determines how a computer file shall be written and displayed on screen or in print.
FIPS	U.S. Federal Information Processing Standards
FM	Facility Management
GDS	Geospatial Data Systems (GDS) consist of any automated system that employs data referenced to a location on the earth.
GeoMedia	The GIS software program developed by Intergraph, Inc., registered and trademarked by Intergraph, Inc.
GFM	Government Furnished Materials
GIS	Geographic Information System
GPS	Global Positioning System
HTRW	Hazardous, Toxic, or Radioactive Waste
IGES	Initial Graphics Exchange Specification
Informix	A relational database management system developed by Informix Software, Inc., registered and trademarked by Informix Software, Inc.
IP	Image Processing
ISO	International Standards Organization
LADGPS	Local Area Differential GPS
Line style/type	A specific line pattern which type has vector properties and is used to delineate between different graphical entities which are represented by lines or polygons.
Links	An electronic relationship between similar attributes or fields in a database.
LIS	Land Information System

MGA	Modular GIS Analysis
MGE	Modular GIS Environment, The GIS software program developed by Intergraph, Inc., registered and trademarked by Intergraph, Inc.
MicroStation	The CADD software program developed by Bentley Systems, Inc., registered and trademarked by Bentley Systems, Inc.
MLLW	Mean Lower Low Water
MS-DOS	Microsoft Disk Operating System, a registered trademark of the Microsoft Corporation. Software that allows application programs to interact with the computer's hardware and translates the user's commands.
NAD	North American Datum
NAD27	North American Datum of 1927
NAD83	North American Datum of 1983
NAVD	North American Vertical Datum
NAVD88	North American Vertical Datum, 1988
NAVOCEANO	Naval Oceanographic Office
NGVD29	National Geodetic Vertical Datum 1929
NIST	National Institute of Standards and Technology
NOS	National Oceanic Survey
NSDI	National Spatial Data Infrastructure
NSRS	National Spatial Reference System
OCONUS	Outside the Continental United State
ODBC	Open Database Connectivity
OMB	Office of Management and Budget
Oracle	A relational database management system, developed by Oracle Corporation, registered and trademarked by Oracle Corporation.
Origin	In coordinate geometry, the point where the X, Y and Z axis's intersect.
OS	Operating system, computer software program, which provides commands and functions used by other computer programs to communicate with the computer hardware equipment.
Paint	A software program using pixel program (raster) images to permit electronic painting and drawing.
Path	The route consisting of drive and directory address used by the operating system to find a program or file.
Pattern	A specific configuration of lines, dots, or other graphical objects used to aid in delineating graphical features.
PCA	Personal Computer with an Intel or Intel-compatible CPU.
Pixel	Tiny dots grouped together to form the images displayed on the computer screen.
PKZIP/PKUNZIP	A shareware utility computer software program which provides for compression and decompression of programs and files.
PL	Public Law
Plane	A spatial element in geometry that may or may not have a boundary, but is level, having no elevations or depressions, and is two-dimensional.
QA	Quality Assurance

QC	Quality Control
QCP	Quality Control Plan
Relational Database	A database management system that uses SQL, the System (RDBMS) structured management query language originally developed by IBM, to implement and query data in relational tables.
Relational Interface	A generic relational database interface that isolates the differences in specific vendors' relational database management systems.
Resolution	A means for defining the sharpness or clarity of a computer image made of pixels, the higher the resolution, the clearer the image.
RMP	Responsibility Management Program
RMSE	Root Mean Square Error
Scanner	An electronic device, which converts an image from paper into a raster image stored in an electronic computer file.
SDSFIE	Spatial Data Standard for Facilities, Infrastructure, & Environment
SDTS	Spatial Data Transfer Standard
Software	An electronic digital program, which contains instructions used to perform certain tasks on a computer or to manage a computer's operation.
SOW	Statement of Work
SPCS	State Plane Coordinate System
SQL	Structured query language. Originally developed by IBM for creating, modifying, and querying relational databases. Has evolved into an ANSI, ISO, and FIPS standard.
Target	The type of computer hardware, CADD operating system software, basic system CADD software, CADD application software, and database software on which the data from a digital CADD file must be directly accessible without translation or preprocessing.
Target Installation	An Installation, office, or organization, which shall be using the CADD-generated data and files.
Text font	Specific style and size of letters, characters, and numbers.
TM	USACE Technical Manual
UNIX	The operating system and family of related utilities originally developed by AT&T Bell Laboratories.
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
Vector	A quantity possessing both magnitude and direction, generally represented by a line. Vectors can be manipulated geometrically and are represented as a coordinate triple (X, Y, Z).
WAAS	Wide Area Augmentation System
Windows	Windows operating system software, a registered trademark of the Microsoft Corporation. Software that provides a graphical interface, allowing application programs to interact with the computer hardware and translates the user's commands

APPENDIX B: BASE FACILITY STANDARD CHECKLIST

Note: This document is meant to be an abridged version of the BFS and not to replace it.

1.0 INTRODUCTION

1.3 General Points of Contact – Base Level

General points of contact (POC) have been contacted and provided an opportunity to review/comment the design at the concept (10%) and pre-final (95%) at a minimum. Additional design review coordination with applicable POCs as required. Documentation of design comments and coordination are retained in the design file.

2.0 STANDARD DESIGN REFERENCES & CRITERIA

2.2 Code Analysis

A comprehensive code analysis including all applicable local, state, national, and Air Force codes has been accomplished clearly identifying any structural, fire, safety, etc. requirements and deficiencies.

A comprehensive summary of specific code references has been accomplished including, at a minimum the International Building Code (IBC) and NFPA 101 Life Safety Code. The code summary is included in the final design documents located immediately after or incorporated into the project title sheet.

2.3 Field Investigation of As-builts

The record drawings and any existing site and building data has been obtained from the 88 Civil Engineer Group Engineering Division (88 CEG/CEN), Installation Management Division (88 CEG/CEI), and 88 Civil Engineer Squadron (88 CES/CEO), as well as the facility Real Property Building Manager (RPBM) and current using organization as applicable. Existing record data has been verified through exhaustive field investigations and testing of facilities, site and supporting utilities. Deviations from the record data and existing field conditions have been documented and integrated into the final design documents.

2.4 Specifications

Construction project technical specifications have been properly compiled using SpecsIntact to edit the Unified Facility Guide Specifications (UFGS) incorporating the specific project requirements in a single PDF file.

Mandatory WPAFB Master Specification sections 01 01 00, 01 01 50, 01 02 20, and 01 33 00, and any applicable optional WPAFB Master Specification sections have been incorporated into the final construction specification.

2.5 CADD Standards

Final design drawings have been accomplished and complied in strict accordance with the WPAFB CADD Standards included in Appendix A.

2.6 DD Form 1354 Requirement

____ Designer shall provide a completed Draft DD Form 1354 for all designed construction projects. Design documents shall include the requirement that contractors shall complete and submit Final DD Form 1354 for all construction projects.

2.7 BUILDER Updating

____ Design documents shall include the requirement that contractors shall complete and submit BUILDER Update Form for all construction projects.

2.8 Lay Down Area

____ A specified lay down area to store project materials and equipment for the duration of a construction project shall be provided as part of the Design Drawings. The lay down area shall be sufficiently sized to accommodate trailers, construction materials, and equipment traffic. The lay down area shall be located within a reasonable proximity to the project area to minimally impact roads, and utility tie-ins shall be taken into consideration. A minimum 6ft tall chain-link fence with privacy fabric shall be provided along its perimeter in prominent areas to create a privacy screen from the surrounding context.

3.0 ARCHITECTURAL**3.3 Historic Preservation**

____ Design has been reviewed by the Base Cultural Resources Manager (CRM), and if required, forwarded to the State Historic Preservation Office (SHPO) for review and approval. CRM and SHPO comments have been integrated into the final design documents.

3.4 Sustainable Design

____ Designs and process incorporate sustainable design principles and strategies.

3.5 Handicapped Accessibility

____ Accessibility issues conform to the codes and guidance provided by the Architectural Barriers Act Accessibility Standards (ABA), and provides adequate accessibility to facilities regardless of the military exclusions granted by the Uniformed Federal Accessibility Standards.

3.6 Base Comprehensive Planning (BCP)

____ Design has been reviewed by the 88 CEG/CENPL for compliance with existing Base plans. Comments have been integrated into the final design documents.

____ An approved siting package has been accomplished for projects adding square footage to the base inventory.

3.7 Architectural Finishes

____ The architectural compatibility of the site, the building, and neighboring buildings were considered in the design. If appropriate, the Architectural Review

Committee (ARC) has reviewed the design and comments have been integrated into the final design documents.

3.8 Roofing

Roof design has been accomplished in strict accordance with applicable guidance, standards and policies for the specific roof type and application within the scope of the subject project.

Project site has been tested for existing asbestos containing materials and design includes appropriate mitigation drawing details and specification requirements.

3.9 Fenestration

Selection of window and glazing materials has been based on life cycle cost considerations, as well as human comfort considerations.

3.10 Signage

Exterior facility signs comply with WPAFB, AF and UFC sign standards.

Interior signage as required has been incorporated into the final design.

3.11 Landscaping

Landscape plans and plantings conform to the WPAFB Recommended Plantings.

Lawn repair and maintenance has been addressed in the final design drawings and specifications.

Designed barriers are based on the three acceptable screening types: masonry, chain link fencing, and wood fencing. If appropriate, the ARC has reviewed the design and comments have been integrated into the final design documents.

3.12 Interior Design Standards

The furniture plans show the user's functional requirements can be accommodated within the spaces, comply with the Section 4.0 Interior Design, and satisfy applicable NFPA 101 Life Safety requirements.

If furniture/furnishings are included as part of the construction contract the requirement is properly identified on the Bid Schedule. If they are not included, the furniture/furnishing plans are clearly noted "For Reference Only."

3.13 Energy Conservation

Design promotes improving energy efficiency and reducing energy consumption and costs and has been reviewed by the appropriate individuals in the Energy Management Section (88 CEG/CENPE). Comments have been integrated into the final design documents.

3.18 Exterior Finish and Color Schedule

The design details and specifications provide adequate documentation clearly indicating the materials, colors, and design elements used. If appropriate, the ARC has reviewed the design and comments have been integrated into the final design documents.

4.0 INTERIOR DESIGN

4.1 General

Design has been reviewed by an 88 CEG/CENMP Interior Designer. Comments have been integrated into the final design.

4.3.5 Restroom Accessories

Government provided/contractor installed restroom accessories have been properly identified and located.

4.3.6 Furnishings, Fixtures & Equipment

Furniture systems are fully coordinated with facility architectural layout, finishes and supporting mechanical, electrical, communication/data and fire protection systems.

Artwork has been reviewed by an 88 CEG/CENMP Interior Designer and approved by the appropriate RPBM.

Interior signage has been properly identified and is in compliance with UFC 3-120-01 Air Force Sign Standard.

4.4 Federal Prison Industries (UNICOR)

Requirement for UNICOR waivers-, if applicable, has been identified/initiated.

4.5 Interior Work Space Usage/Criteria

The layout of interior spaces, including personal work space, traditional walled offices, administrative support spaces, and specialty spaces meet the WPAFB goals outlined in the BFS and Air Force Manual 32-1084.

5.0 CIVIL/STRUCTURAL

5.1 Sanitary Sewer

Design has been reviewed by the 88 CEG/CENMP Water/Sanitary/Waste Treatment Engineer and the 88 CES/CEOER Mechanical Infrastructure Engineer. Comments have been integrated into the final design.

General Note on plans acknowledging A/E (or Design Manager if in-house design) responsibility to coordinate with 88 CEG/CEIE to obtain Ohio EPA permit.

5.2 Water Systems

Design for water connections includes meter, if applicable, and a reduced-pressure back-flow prevention device installed within 36" of the connection point.

Design has been reviewed by the 88 CEG/CENMP Water/Sanitary/Waste Treatment Engineer and the 88 CES/CEOER Mechanical Infrastructure Engineer. Comments have been integrated into the final design.

General Note on plans acknowledging A/E (or Design Manager if in-house design) responsibility to coordinate with 88 CEG/CEIE to obtain Ohio EPA permit.

5.3 Storm Sewer

Design has been reviewed the by the 88 CEG/CENMP Water/Sanitary/Waste Treatment Engineer and the 88 CES/CEOER Mechanical Infrastructure Engineer, in particular the flow of rain water on and around the site insuring that incidents of ponding and flooding has been properly eliminated. Comments have been integrated into the final design.

General Note on plans acknowledging A/E (or Design Manager if in-house design) responsibility to coordinate with 88 CEG/CEIE to obtain Ohio EPA permit.

5.4 Airfield

Design has been reviewed by the 88 CEG/CENMP Pavement/Airfield Pavement Engineer and the 88 CES/CEOER Mechanical Infrastructure Engineer. Comments have been integrated into the final design.

5.5 Roadway and Traffic Considerations

Traffic and directional signage shall conform to the MUTCD and WPAFB color palette.

Handicapped parking and curbing design conforms to the ABA and the Uniform Federal Accessibility Standards.

Design has been reviewed by the 88 CEG/CENMP Traffic Engineer and the 88 CES/CEOER Mechanical Infrastructure Engineer. Comments have been integrated into the final design.

5.6 Structural

Design has been reviewed by the 88 CEG/CENMP Structural Engineer. Comments have been integrated into the final design.

6.0 ENVIRONMENTAL

Design has been reviewed by all appropriate offices in the Civil Engineer Installation Management Division including the Base Community Planner, the Environmental Manager and the Base Cultural Resources Manager. Comments have been integrated into the final design.

6.1 Permits

All required permits have been completed and coordinated with the Civil Engineer Installation Management Division.

6.2 Air Quality

Class I Ozone Depleting Substances (ODS) have not been used for refrigeration or cooling.

6.3 Asbestos

_____ A thorough project environmental survey has been conducted to determine if Asbestos Containing Materials (ACM) and other hazardous materials are present and comments have been integrated into final design.

6.4 Environmental Impact Analysis

_____ Verification with 88 CEG/CEIEA that Environmental Impact Analysis Process (EIAP) and/or an Environmental Assessment (EA), if required, has been initiated and completed prior to final design and comments have been integrated into final design by the Program Manager.

6.7 Historic Preservation Requirements

_____ Proposed work on or near historic property has been reviewed by the 88 CEG/CEIEA, Cultural Resources Manager. Verification with 88 CEG/CEIE that Section 106 has been completed prior to final design and comments have been integrated into the final design.

6.12 Natural Resources

_____ Project design complies with guidelines for removing and cutting trees. The project design complies with procedures to avoid and minimize impact of the Indiana bat habitat.

_____ Project design complies with the 100-Year Floodplain/Huffman Retarding Basin Requirements (Miami Conservancy District [MCD] Land Use Policy) including established MCD building restriction and fill material policies for activities within the floodplain.

6.15 Underground Storage Tanks (UST)/Aboveground Storage Tanks (AST)

_____ Project designs involving any actions with USTs or ASTs shall be coordinated through the Storage Tank PM to ensure all UST/AST regulatory concerns are addressed.

6.16 Water, Wastewater and Stormwater

_____ For drinking water, a Plans Approval application must be sent to the Water PM for construction of a water main for a new building, addition to a building, replacing a main that is larger than an existing main or extending a main.

_____ For wastewater, Permit To Install applications must be sent to the Water PM for construction of wastewater collection, conveyance, storage, treatment or disposal facilities.

_____ Design to install oil/water separators (OWS) shall be coordinated with and approved by the 88 CEG/CENMP Water/Sanitary/Waste Water Engineer and 88 CES/CEOER Mechanical Infrastructure Engineer.

_____ Designer shall submit Operation & Maintenance Manuals for any post-construction best management practices that are to be included as part of the project design IAW the Ohio EPA Construction General Permit.

6.17 Green Procurement

Where applicable, the design has incorporated the use of environmentally preferable products and services in accordance with one or more of the established Federal “green” procurement preference programs.

7.0 MECHANICAL

7.1 Introduction

Design has been reviewed by the 88 CEG/CENMP Mechanical HVAC & Plumbing Engineer, the 88 CES/CEOER Mechanical Infrastructure Engineer, as well as the 88 CEG/CENPE Energy Management Section. Comments have been integrated into the final design.

7.2 Air Conditioning Systems, Chiller, and Air Handling Systems

Equipment is located to allow reasonable access for maintenance. Isolation is provided on mechanical equipment. Bypasses are installed on strainers.

Air Handler is Trane M-Series or better.

Chilled water systems do not require draining to prevent exposed coils from freezing.

Propylene glycol with zero silicate content is specified in water/glycol systems. Glycol make-up package must be included in design.

Controls are compatible with BACnet or LONtalk. DDC controls are compatible with EMCS in Bldg 22.

7.3 Heating Systems

Base steam shall not be used for humidification.

Tunnels in Area B are used for steam only, exceptions must be approved by the Mechanical Infrastructure Engineer in 88 CES/CEOER.

7.4 Natural Gas

Location of connection to gas lines must be approved by government.

Meter shall be included in design.

7.5 Plumbing

Proper access has been provided for maintenance of plumbing fixtures, valves, etc as required.

Design does not include waterless/tank type urinals or water closets.

7.6 Heating, Ventilation, and Air Conditioning (HVAC) Controls

New connections to EMCS have been made through the CE VLAN. Two LAN drops have been provided for in the design.

Controls are compatible with existing EMCS without 3rd party devices or software.

7.7 Corrosion Control

_____ Design complies with required corrosion control codes and standards.

7.8 Water Treatment

_____ Required water treatment systems, including backflow preventers, have been provided for hot/chilled water systems.

8.0 FIRE PROTECTION**8.1 General**

_____ Design has been reviewed by the 788 CES/CEXFP Fire Prevention Office and the 88 CEG/CENMP Fire Protection Specialist - Alarm/Detection & Sprinkler Systems. Comments have been integrated into the final design.

8.2 Fire Alarm Systems

_____ The alarm system is addressable, capable of monitoring all points within the facility and capable of providing emergency voice message.

_____ Design includes a Knox Box.

8.4 Automatic Sprinkler Protection

_____ Drawings/specifications include water flow test.

_____ Design includes a backflow preventer.

_____ Valves, gages, switches, etc. are located to facilitate ease of inspection, maintenance and repair.

8.6 Mass Notification

_____ Mass Notification System (MNS) is in separate cabinet from Fire Alarm Control Panel and shall be capable of playing recorded and live announcements. The location of the MNS has been coordinated with the user and Fire Department (788 CES/CEXF).

9.0 ELECTRICAL**9.1 General**

_____ Design has been reviewed by the 88 CEG/CENMP Electrical Engineer and the Electrical Infrastructure Program Manager, as well as the 88 CEG/CENPE Energy Management Office. Comments have been integrated into the final design.

_____ Design includes an electric meter, if applicable.

9.2 Drawings, Specifications, and Design Requirements

_____ A load analysis, short circuit analysis, a coordination study for new distribution systems, life cycle analysis, voltage drop, lighting calculations have been accomplish as appropriate for this project.

9.8 Energy Metering

_____ The Energy Meter, associated wiring, CT shorting blocks, PT disconnect or fuses, and Ethernet connectivity device shall be mounted within a separate metering compartment of the Main Distribution Panel, or in a remote cabinet separate from the MDP.

10.0 TELECOMMUNICATIONS**10.1 General**

_____ Design has been reviewed by the Base Communications Office in 88 CG/SCXI. Comments have been integrated into the final design.

10.2 Communications Equipment Room (CER)

_____ Facilities greater than 10,000 sq. ft. in floor area must have a CER. CER is sized in accordance with "Entry CER Sizing Table 1".

_____ CER has ¾" fire rated plywood backboards on all walls from no greater than 1' above finished floor to no less than 7' above finished floor.

_____ Cable ladder/tray is installed around the perimeter of the room and across the middle above the height of the cabinet/racks.

_____ A minimum of two dedicated non-switched 20-amp, 120-VAC outlets, each on a separate branch circuit for each communications equipment rack has been provided.

_____ The main CER has both equipment and a separate lightning protection ground busbar installed.

10.12 Equipment Racks

_____ Project is provided with equipment racks in the CERs as required. The racks shall have vertical and horizontal cable management.

APPENDIX C: UFGS EDITING NOTES

Section 21 13 13.00 10 Wet Pip Sprinkler System, Fire Protection

Para 2.5.1.1 – Rewrite second sentence to read “All steel sprinkler piping shall be schedule 40.”

Jim Levy – 3 Feb 2016

Section 23 00 00 Air Supply, Distribution, Ventilation, and Exhaust Systems

Para 2.10.1 - Add: Fiberglass duct board prohibited in all designs.

Para 2.10.1.1 – Change 6 feet to 5 feet.

Para 2.10.1.2 – Change 6 feet to 5 feet.

Jay Thompson – 28 Feb 2013

Section 23 52 00 Heating Boilers

Para 3.14 – Add paragraph: “Per AFI 91-203, written operating instructions and detailed checklists for operator guidance shall be posted in all equipment rooms with boilers. All functions shall be included, whether manual or automatic.”

Jake Swogger – 10 Mar 2014

Section 23 05 93 Testing, Adjusting, and Balancing For HVAC

Para 3.3.3 - Add: For grease ducts, prior to insulation being installed the entire duct system shall be liquid tight leak tested in lieu of a DALT.

Para 3.3.4 - Add: For grease ducts, a liquid tight leak test shall be performed using two methods. Method one shall be an air pressure test. During the air pressure test, ducts shall maintain 1” water column positive pressure for a minimum of 20 minutes. Method two shall be conducted with high pressure steam (500 psi, 305°F) using the same procedures as grease duct cleaning. For the liquid tight leak test to be considered acceptable, grease ducts must pass both methods of testing.

Jesse Poorman & Jeff Kitzmiller – 27 Apr 2012

Section 26 05 13 Medium-Voltage Cables

Para 3.1 – Add: “For cable terminations over 600V a hydraulic 15-ton elliptical crimp will be used. This crimp requires two passes, 90 degrees apart to form a full crimp. A 15-ton ratchet-type or hydraulic-type crimper that only releases when full rated crimp pressure is attained, is required for all crimps.”

Tyler Johnson – 20 Mar 2013

Section 28 31 76 Interior Fire Alarm and Mass Notification System

Para 3.7.2.3 – After second sentence, add “A minimum of 3 days prior to fire alarm acceptance test, a pre-test must be completed and everything must be functioning correctly, to include the fire alarm panel, initiating devices, and notification devices. There shall be no trouble alarms on the panel the day of the final acceptance test.”

Para 3.7.2.3.a – Rewrite to read “A manufacturer representative trained and certified in the type of fire alarm system being tested shall be at the final acceptance test.”

Dan Sharp & Jerry Bridenbaugh – 3 Feb 2016

Section 31 00 00 Earthwork Changes

Para 1.1 & 1.2 – Delete complete paragraphs. Normally projects are bid lump sum.

Para 1.3 c., d., & e. – Discuss with DESIGN MANAGER whether soil character is known or not. If soil character is not known, or if underground work is located east of “C” Street in Area B then provide soil borings. Where borings are not needed provide description of soil and water table.

Para 1.3 f. – Re-write para based on discussion with DESIGN MANAGER and soil borings. When rock is not expected state, “Rock excavation is not expected. If rock is encountered change conditions shall apply”. When rock is expected state, “Excavation shall include removal of ALL material encountered”.

Para 1.5.1 – Delete CL, ML, CL-ML, CH, and MH from list. Re-write last sentence to read, “Satisfactory fill material for pavements and railroads shall be comprised of stones less than 3 inches in any dimension”.

Para 1.5.5 – Delete.

Para 1.5.6 – Re-write first sentence to read, “Material suitable for topsoils obtained from offsite areas, or excavations is defined as: ...”.

Para 1.5.7 – Delete, “with stones greater...whichever is smaller”.

Para 1.5.8 – Fill in blank with 1.0 cubic yard.

Para 1.5.10.1 – Replace to read, “Select granular material shall consist of well graded sand, gravel, crushed gravel, crushed stone, or crushed slag. Material shall be composed of hard, tough, and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 sieve and no less than 95 percent by weight passing the 1 inch sieve. The maximum allowable aggregate size shall be $\frac{3}{4}$ inch or the maximum size recommended by the pipe manufacturer, which ever is smaller”.

Para 1.5.10.2 – Delete.

Para 1.5.11 – Fill in blank with $\frac{3}{4}$ inches. Delete second (last) sentence.

Para 1.5.12, 1.5.13, 1.5.14 – Delete unless there is a specific need, in which case fill in blanks as needed.

Para 1.6 – Re-write to read, “Subsurface boring logs are shown on the drawings. The subsoil investigation report is appended to this specification. These databoring locations”. Include boring logs on the drawings, and include the report in the specifications.

Para 1.6.1 – Either use first sentence or second, but not both.

Para 1.6.1.2 – Change $\frac{1}{2}$ cubic yard to 1.0 cubic yard (in two locations).

Para 1.6.2 – Delete all but the last sentence.

Para 2.1 – Discuss with DESIGN MANAGER. Typically change to read, “Offsite soils shall be clean material, free from oils, petroleum, or toxic material”.

Para 2.4 – Delete complete paragraph. When rip rap is used, specify ODOT 703.19 Type B or C size.

Para 2.5 – Delete when water barrier is not used.

Para 2.6 – Delete when casing pipe is not used.

Para 3.2 – Re-write middle sentences to read, “The contractor shall dispose of surplus satisfactory excavated material not required for fill or embankment, and unsatisfactory excavated material shall be disposed of by the contractor”. Re-write last sentence to read, “Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be provided by the contractor”.

Para 3.2.4 – Fill in blank with 2 feet.

Para 3.2.5 – Fill in both blanks with 5 feet. Change 24 inches plus pipe outside diameter to 18 inches and change 36 inches plus pipe outside diameter to 24 inches.

Para 3.2.5.2 – Fill in blank with 6 inches.

Para 3.2.6 – Filling in blank with two feet would be similar to WPAFB Master 01 01 50 Spec except for comm., fuel, and gas where 01 01 50 said five feet. WPAFB Master 01 01 50 is used for all designs. This paragraph should reference WPAFB Master 01 01 50.

Para 3.2.6 – Add following at the start of the paragraph, “Location of the existing utilities indicated is approximate. The contractor shall physically verify location and elevation of the existing utilities indicated prior to starting the construction. The contractor shall process an AF 103 Form Clearance Request for assistance in locating existing utilities”.

Para 3.2.6 – Add following sentence at the end of the paragraph, “Any abandoned utility damaged or otherwise cut during excavation or backfill shall be capped and sealed watertight.”

Para 3.3 – Re-write second sentence to read, “Borrow material shall be obtained by the contractor”. Also delete remainder of paragraph.

Para 3.8.2 – Edit second last sentence to read, “Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used”.

Para 3.9 – Re-write first sentence to read, “Unsatisfactory materials removed from the excavations shall be disposed of by the contractor”. Re-write fourth sentence to read, “Satisfactory material authorized to be wasted shall be disposed of by the contractor”. Delete fifth sentence.

Para 3.10.2 – Edit when detection wire is used for gas lines.

Para 3.11.1.3 – Re-write fifth sentence to read, “Except as specified more stringently in the individual piping sections, bedding support for utilities shall consist of a minimum of 4 inches or $\frac{1}{4}$ the diameter of the utility, whichever is greater, of select material. Bedding shall be continued upward for the full width of the trench to 12 inches above the top of the utility (combined bedding and cover). All material shall be compacted to 95 percent of ASTM D 1557 maximum density”. Delete all of the remainder of the paragraph.

Para 3.11.1.4 b. – Re-write second, third and fourth sentences to read, “Water flooding or jetting methods of compaction shall not be permitted”.

Para 3.11.2 – Fill in blank with 3 days.

Para 3.12.2 – Fill in blank with 4 feet. Delete last sentence.

Para 3.12.5 & 3.12.6 – Delete complete paragraph when absorption trench or casing pipe is not used.

Para 3.12.7 – Delete complete paragraph when rip rap is not used. Edit as needed. Typically use Type B or C size fill on filter fabric with no grout.

Para 3.13 – Delete complete paragraph when embankments are not used. Edit as needed.

Para 3.14 – Delete complete paragraph for utility work. For road work, or new building work edit as needed.

Para 3.17 – Fill in blank with 4 inches.

Para 3.18.1, 3.18.2, 3.18.3 – Edit number of test as required for importance of work but insure that at least two tests are performed.

Para 3.19 – Re-write to read, “Surplus material...timber shall be removed from Government property”.

Include following paragraphs from previous specification under Para 3.2 or as notes on the drawings:

B. Removals

1. Removal of existing pavement, curb, sidewalks, base, gravel, soil, including all steel reinforcement contained within, shall be accomplished in such a manner that the pavement, base and portions of other installation, that are to remain in place, will not be damaged in any way. Pavement, curb, sidewalk, base, and other installations that are to remain in place, which have been damaged by the contractor's operations, shall be repaired by the contractor at no cost to the Government.
2. Where it is necessary to cut existing pavement, curbs and gutters, and sidewalks, contractor shall saw cut each with an approved power saw, making neat, parallel, straight lines prior to any removal. For asphalt pavement cut shall be made at least 1 foot wider than trench width on each side of the trench and at least 2 inches deep. For concrete surfaces, cut shall be made for the full depth and extend to the nearest joint (minimum 1 foot) on each side of the trench.
3. For all pavement cuts a temporary road surface of steel bridging, gravel, or crushed stone shall be used as approved. The temporary road cut will be filled with crushed stone and compacted. Steel plates may be used as a temporary cover in lieu of the crushed stone. After five (5) days the road cut must be completely reconstructed per final plans and specifications. Deviation from this requirement can be waived by the contracting officer if construction requirements warrant. This decision, however, rest with the contracting officer. Traffic must be maintained at all times unless approved.
4. Where installation/replacement of road cuts is required and not specified or shown, the contractor shall match x-section as original, using the same materials or better, as determined by the contracting officer. No pavement shall be replaced until trench has been backfilled as specified. Temporary materials shall be completely removed and disposed of when permanent pavement is replaced.

5. Where necessary trees, shrubs, bumper blocks, fences, signs and other miscellaneous items shall be removed, preserved, and reinstalled in kind. When removal is not necessary such items shall be protected from damage.

Carl J. Vehorn – 11 Apr 2005/Revised 19 Sep 2007/Checked with no changes 24 Nov 2010/Revised 10 Oct 2012

Rick Baumann – Revised 19 Jul 2006/Revised 23 Apr 2010

Section 32 92 19 Seeding Changes

Para 1.3 – Edit as required. Typically only Section 31 00 00 (02300) applies. Section 32 92 23 will apply if work is in the Bricks or other high interest locations, and 32 93 00 will apply if trees are being planted. Section 32 05 33 is a good summary section that may be useful if landscaping is a large dollar value part of the project. If any of Sections 32 92 23, 32 93 00, or 32 05 33 are used, then coordinate similar paragraphs in those sections with the changes listed here.

Para 1.5.1.2 and 1.5.2.1 – Edit as required. Typically only seed, fertilizer and possibly iron apply.

Para 2.1.2 – Fill in Season 1 as April 10 to June 1, Season 2 as August 7 to October 7, and note Temporary as “year wide”.

Para 2.1.3 – Delete the table and fill in as follows: Minimum pure live seed shall not be less than 75% computed as % Purity x % Germination. Maximum percent weed seed shall not be more than 0.5%. Seed mixture shall be equal to 85% Festuca Arundinacea (Tall Fescue), and 15% Lolium Multiflorum (Annual Ryegrass).

NOTE: No millet of any kind shall be planted on WPAFB.

Para 2.1.4 – Delete the table. Edit first sentence to read, “Proportion seed mixtures by weight as noted above”.

Para 2.2.2 – Edit last sentence to read, “Additional topsoil shall be furnished by the contractor”.

Para 2.2.3 – After the first sentence add the following, “Topsoil shall be a natural friable loamy soil”. Use the left hand numbers in the table.

Para 2.3.1 – Edit to read, “Lime shall be agricultural grade ground limestone”.

Para 2.4.1 and 2.4.2 – Fill in blanks with 12% nitrogen, 12% phosphorus, 12% potassium, 5% sulfur and 5% iron.

Para 2.6 – Edit to read, “Water will be available from Base fire hydrants with coordinated approval from the Fire Department. Provide a reduced pressure backflow preventer on any connections to a fire hydrant”.

Para 2.7.1 – Edit to read, “designed to degrade within 6 months”.

Para 2.7.2 – Edit last sentence to read, “minimum life of 6 months and no longer than 9 months”.

Para 2.7.3 – Edit in part to read, “medium” in lieu of “heavy”, and to read, “0.84” in lieu of “1.22”.

Para 3.1.1.2 – Fill in the blanks to read as follows: lime 1 pound per 1,000 square feet, sulfur 2 pounds per 1,000 square feet, iron 5 pounds per 1,000 square feet, aluminum sulfate 1 pound per 1,000 square feet, peat 2 cubic yards per 1,000 square feet, sand 1 cubic yard per 1,000 square feet, perlite 1 cubic yard per 1,000 square feet, compost derivatives 1 cubic yard per 1,000 square feet, calcined clay 0.5 cubic yards per 1,000 square feet, and gypsum 0.5 cubic yards per 1,000 square feet..

Para 3.1.1.3 – Fill in blank for fertilizer as needed. Typical rate is 10 pounds per 1,000 square feet.

Para 3.2.2 – Edit and fill in blanks (para 3.2.2.1/2/3) as needed. Typical seeding rate is 8 pounds per 1,000 square feet.

Para 3.3 – Add the following sentence, “Contractor shall be responsible for mowing the seeded area to a height of 3 inches whenever the grass reaches a height of 6 inches.”

Para 3.4 – It is assumed that this requirement would be for lawn areas slightly damaged by the contractor, where the procedures may be used in lieu of complete re-top soiling and seeding. In para 3.4.1 change the second sentence and following to read in part, “... to a minimum depth of 2 inches. Leave all soil plugs that are produced in the turf area. After aeration operations are complete, top-dress entire area 0.5 inches depth with a manufactured “top soil” mixture. Blend all parts...”.

Carl J. Vehorn – 20 Jun 2005/Revised 26 Mar 2010 & 26 Apr 2010/Checked with no changes 24 Nov 2010/Revised 9 Oct 2012
Rick Baumann – Revised 8 Sep 2006

Section 33 11 00 Water Distribution Changes

Para 1.2 – Delete wording, note as not used.

Para 1.3.1 – Delete all piping but ductile-iron and polyvinyl chloride (PVC) plastic. Delete second paragraph.

Para 1.3.2 – Delete all piping but copper pipe, copper tubing, and polyvinyl chloride (PVC) plastic. Delete second paragraph.

Para 1.4 – Include as Government required submittals the following: 1. Catalog cuts of pipe, fittings, valves, and specials; 2. Certification that pressure and leakage test have been completed

and approved; and 3. Certification that disinfection has been completed and provide copies of satisfactory bacteriological test results.

Para 1.5.2.1 & 1.5.2.2 – Delete wording, note as not used.

Para 2.1.1.1.a – Call out pressure class 350 psi and thickness class 52.

Para 2.1.1.1.c – Call out pressure class 235 psi and DR 18.

Para 2.1.1.3/4/5/6/7 – Delete wording, note as not used.

Para 2.1.2 – General for all valves, delete wording and note as not used unless such a valve is part of the project.

Para 2.1.2.7 – Delete, “wet barrel type”. Add to second sentence, “and use color in accordance with NFPA pressure recommendations for hydrants in potable water systems”.

Para 2.1.2.8 – Delete wording, note as not used.

Para 2.1.2.9 – Edit to read, “Provide for all sprinkler system valves and include electronic tamper switch with zone addressable module connected to the nearest fire panel.”

Para 2.1.2.11/12/13/14 – General, delete wording and note as not used unless such an item is part of the project.

Para 2.2.1.3 d/e/f – Delete wording, note as not used.

Para 2.2.1.4/5/6/7 – Delete wording, note as not used.

Para 2.2.2.14/15/16/17 – Delete wording, note as not used.

Para 3.1.1.3 – Change last sentence to read, “Depth of cover...not less than 4 feet.”

Para 3.1.2.3/4/5/6/7 – Delete wording, note as not used.

Para 3.1.4.3/4 – Delete wording, note as not used.

Para 3.1.5 – Change second sentence to read, “Disinfect new water piping...in accordance with AWWA C651-05 including the optional procedures listed in Section 4.3.9 Backflow Protection and Section 4.6 Final Connections to Existing Mains.”

Carl J. Vehorn –20 Apr 2005/Revised 20 Sep 2007/Revised 18 Apr 2008/Checked with no changes 24 Nov 2010/Revised 3 Oct 2012

Section 33 11 23 Natural Gas and Liquid Petroleum Piping

Para 1.3 – Add the following (G) designated Submittals “PHMSA Form 1: Report of Main and Service Line Inspection” and “PHMSA Form 16: Pipeline Test Report”.

Para 3.2.3 – Change the first sentence to read, “Pressure test to 100 psig.”

Jesse Poorman – 2 Oct 2015

Section 33 30 00 Sanitary Sewers Changes

Para 1.2.1 – Re-write to state, “Provide gravity mains and laterals, including building connections, of size shown on the drawings, of clay pipe, cast iron soil pipe, ductile iron pipe, or polyvinyl chloride (PVC) pipe. Provide each system complete and ready for operation. The system includes equipment, materials, installation, and workmanship”.

Para 1.2.2 – Re-write to state, “Provide pressure lines of ductile iron, or PVC plastic pressure pipe”.

Para 1.3 – Provide “G” designation for following: Shop drawings for manholes, and covers; Product data for pipe fittings and specials; Test report for pressure test and mandrel test.

Para 2.1.1.1 – Delete “extra heavy”.

Para 2.1.2.1 – Delete “standard strength”.

Para 2.1.3 & 2.1.4 – Delete complete paragraphs, note as not used unless there is a specific need.

Para 2.1.7 & 2.1.8– Delete complete paragraphs, note as not used unless there is a specific need.

Para 2.1.9.1 – Delete last sentence, “ASTM F794 Series...inch diameter”.

Para 2.1.12 & 2.1.13 – Delete complete paragraphs, note as not used unless there is a specific need.

Para 2.1.14 – Delete when casing pipe is not needed, note as not used unless there is a specific need.

Para 2.3.1 – Delete reference to Glass Fiber Reinforced Polyester manholes.

Para 2.3.4.1 – Re-write to state, “Provide Neenah Foundry Model R-1767, or East Jordan Iron Works Model 1600, or equal casting unless otherwise specified.

Para 2.3.4.4, 2.3.4.5, & 2.3.5 – Delete when septic tank and absorption pipe are not needed, note as not used unless there is a specific need.

Para 3.1.1.2 – Fill in blank as needed, normally 31 00 00 Earthwork.

Para 3.1.1.3 – Re-write second last sentence to state, “Branch connections shall be made by the use of regular fittings”. Delete last sentence.

Para 3.1.2.3 & 3.1.2.4 – Delete complete paragraphs, note as not used unless there is a specific need.

Para 3.1.2.7 & 3.1.2.8 – Delete complete paragraphs, note as not used unless there is a specific need.

Para 3.1.2.11 – Delete when railroad work is not needed, note as not used unless there is a specific need.

Para 3.1.6 – Delete when absorption work is not needed, note as not used unless there is a specific need.

Para 3.2.1 – Fill in blank as needed, normally 01 01 50.

Para 3.2.2.1 b (2), (4), & (6) – Delete wording, note as not used unless there is a specific need.

Para 3.2.3 – Delete second and third last sentences, “Test concrete pressure....per mile of pipeline”.

Carl J. Vehorn – 2 May 2005/Revised 20 Sep 2007/Revised 24 Nov 2010/Revised 9 Oct 2012

Section 33 40 00 Storm Drainage Utilities Changes

Para 1.1 – Delete, note as not used. Typically all projects are bid as lump sum.

Para 1.3 – Catalog cuts and technical details are required submittals for: pipe, fittings, specials and manholes.

Para 2.1.1.1, 2.1.1.3, & 2.1.1.4 – Delete wording, note as not used.

Para 2.1.3 thru 2.1.6 – Delete wording, note as not used. Typically corrugated metal pipe is not used due to corrosive soils.

Para 2.1.7 & 2.1.8 – Delete wording, note as not used unless there is a specific need.

Para 2.1.10.2 thru 2.1.10.4 – Delete wording, note as not used. Typically ASTM D 3034 smooth wall inside and out is the only allowed PVC pipe.

Para 2.1.11 – Delete wording, note as not used unless there is a specific need.

Para 2.3.6 – Delete wording, note as not used.

Para 2.3.7 – Note to Designer to review the Base Facility Standard (BFS), paragraph 5.3.3 for standard drainage structures.

Para 2.3.8.5 thru 2.3.8.8 – Delete wording, note as not used when this type of pipe is not used.

Para 2.7.2 – Delete wording, note as not used.

Para 2.8 – Size rip rap according to design. Use Ohio Department of Transportation (ODOT) Item 703.19 designation of Type A, B, C, or D. Typically Type B or C is used.

Para 3.2 – Note that bedding is defined in Section 31 00 00 Earthwork and shown on the drawings.

Para 3.3.3 thru 3.3.6 – Delete wording, note as not used where type of pipe listed is not used.

Para 3.4.2 – Delete wording, note as not used where type of pipe listed is not used.

Para 3.5.1 – Delete “prefabricated corrugated metal, or bituminous coated corrugated metal” from first sentence. Delete second sentence, “Pipe studs and...are so treated”.

Para 3.7.1, 3.7.2, & 3.7.4 – Note that backfilling and compaction shall also conform to Section 31 00 00 (02300) Earthwork.

Para 3.9 – Delete wording, note as not used unless there is a specific need. Typically painting is not required.

Carl J. Vehorn – 20 Jun 2005/Revised 20 Sep 2007/Revised 24 Nov 2010/Revised 9 Oct 2012
Rick Baumann – Changed section number to match UFGS 23 Apr 2010

Section 33 60 01 Valves, Piping, and Equipment in Valve Manholes

Para 2.5.1 – Change second sentence to read, “All piping in valve manholes shall be steel with joints welded except that joins on 3/4” or smaller on high temperature hot water systems, or 1 1/2” and smaller on steam and condensate systems may be threaded.”

Para 2.6 – Delete paragraph, and replace with “Unless otherwise specified, valves shall comply with the material, fabrication, and operating requirements of ASME B31.1. Valves shall be suitable for the temperature and pressure requirements of the system on which used. Valves for high temperature hot water shall conform to ASME B31.1 Class 300. Valves for steam shall conform to ASME B31.1 Class 150 or 300, as suitable for the application. Valves for condensate services shall conform to ASME B31.1 Class 150. Valves 1 1/2” and smaller shall be threaded. Vales 2” and above shall be flanged. Steam and High temperature hot water valves 4” and larger shall have a 1 1/2” flanged globe bypass valve. Branch for bypass valve shall be installed on either the top or the side of steam piping.”

Jake Swogger – 7 Nov 2013

APPENDIX D: MOLD & HUMIDITY CONTROL

1. Introduction

Mold grows where mold spores, nutrients, correct temperature, and ample moisture are combined. Controlling moisture is the best approach to avoiding mold. Eliminating mold spores is impractical, the organic materials in buildings offer potential mold nutrients, and the temperature in buildings is conducive to mold growth. Thus minimizing moisture by eliminating leaks, drips, and condensation in the wrong places must be addressed. Undesired water and moisture usually comes from problems in either the building envelope or the building mechanical systems or both. Wet materials and surfaces are not always required for mold to grow. Even high humidity conditions contribute to mold growth. Air conditioning systems must be designed to keep space humidity at reasonable levels.

2. Building Envelope

The design of the building envelope must consider removal of all air entry points, cold bridges, multiple vapor barriers and gaps in the insulation system. Attics (with exceptions) and crawl spaces should no longer be ventilated. Interior floor slabs should be separated from foundations by insulated expansion joint materials. Cavity wall insulation should extend down to the footings. Insulated windows should be aligned with cavity wall insulation to remove gaps in the insulation system. Window sills, foundation sills and other veneer wall features should be isolated from the structural backup wall allowing cavity wall insulation to run continuously. Use only thermally broken windows. When designing with metal stud backup wall, apply minimum 1 inch rigid insulation over exterior sheathing to improve thermal performance. Consider the use of new insulation products such as Polyicynene which effectively eliminates air infiltration and vapor transmission.

3. Tight Buildings

Leaks of unconditioned outdoor air brings moisture into the building and leads to condensation on cold surfaces with subsequent wetting of building materials followed by deterioration of the materials and mold growth. Therefore, buildings that are relatively air tight must be the goal. A Ventilated attic directly over an insulated lay-in ceiling, for example, does not represent tight building construction. Keep in mind that a slight pressure difference usually exists between inside and outside the building. Insulation batts alone will not stop air flow through the batt if a pressure difference exists from one side of the batt to the other and should therefore not be the only barrier to outdoor air. Mechanical air handling and exhaust systems are typically designed to bring in more air than they exhaust in attempt to pressurize the building to prevent infiltration of outdoor air. This pressurization however is impossible if the building is full of holes. Pay close attention to the details of construction where walls meet roof to eliminate sources of air leaks. Note that building air tightness is not the same as vapor tightness. Buildings may be

designed with or without vapor barriers depending on the indoor and outdoor conditions; however, air tightness must always be the goal.

4. Air Infiltration and Vapor Barriers

Recent studies have shown that air infiltration/exfiltration is a more significant source of moisture accumulation in walls than water vapor diffusion. Air infiltration barriers (such as Tyvek) resist entry of air in walls that can transport moisture and create condensation problems while allowing water vapor to escape. These barriers also resist wind blown rain and water while protecting wall sheathing.

The use of vapor barriers, vapor retarders, and perm ratings for construction materials in the building envelope must be carefully considered for use by the designer. Vinyl wall coverings, bituminous damp proofing, certain paint systems all have properties which may create vapor retarders. If used, vapor barriers must be placed at a location where the temperature is above the dewpoint temperature in both the heating and the cooling seasons. It is critical to eliminate multiple vapor retarders in wall systems which can trap moisture and create potential mold conditions.

5. Gypsum Board and Wall Finishes

Do not place paper covered gypsum board or other surfaces that may provide nutrients for mold behind wall mounted fan coil units. Because manufacturers provide no rear panel to the fan coil cabinet, the splashed condensate droplets dampen the wall surface behind the fan coil unit. Conventional gypsum board material at this location insures mold growth. Provide a wall liner made of plastic, metal or other material that will not be a nutrient source for mold behind wall mounted fan coil units.

Do not use vinyl wall coverings on the interior surfaces of exterior walls or wall surfaces opposite kitchens or shower rooms. Moisture from these high humidity spaces will be trapped and condense behind the vinyl.

6. Attics

Because mold is becoming more associated with the entry of moisture laden air in the building envelop, it is strongly recommended that ventilated attics be used only in limited applications. However, if an attic is ventilated, do not use a vapor barrier under the insulation installed on top of the ceiling. This is because in the cooling season, this puts the vapor barrier in a location made cold by air discharging from supply air diffusers.

7. Crawl Spaces

Do not ventilate crawl spaces. Doing so introduces moisture to the crawl space which will migrate through floors and condense on the underside of floor coverings. The moisture can also condense on cold pipe surfaces within the crawl space; even the outer surface of the insulation on a chilled water line can easily reach temperatures below the dew point of a ventilated crawl space.

Use a 10 mil vapor barrier on the ground surface to prevent moisture migration from the ground. Cover the vapor barrier with gravel.

8. System Selection/Space Humidity Considerations

Direct humidity control using reheat is rarely necessary except in the most demanding climate control situations such as libraries or museums. Indirect humidity control can reasonably be achieved through thoughtful system design.

The paragraphs below are not meant to dictate equipment or system types. Rather, the goal is to point out the advantages and disadvantages of various systems with regard to space humidity for designer consideration.

Most systems are designed to do a good job of limiting humidity at full cooling load. The problem with high space humidity usually occurs at part load.

Oversized equipment essentially runs at part load all the time, so over sizing must be avoided.

Make sure the occupants need for temperature and humidity are known.

Design systems to limit space relative humidity to 45% instead of the usual 50% at full load. Use an indoor design condition of 78 degF/45% RH.

Design systems to limit space relative humidity to 60% at part load conditions.

Size cooling coils handling outdoor air for the design dry bulb temperature day or the design humidity day, whichever gives the greater coil capacity?

Single Zone Systems:

These systems modulate the supply air temperature in response to the space temperature.

Avoid adding safety factor to the cooling loads. Doing so increases the supply airflow, and with excess airflow comes high supply air temperature which leads to high space humidity.

A typical single zone air handling system serving a small office area is an example. Assess the cooling loads carefully and do not arbitrarily increase airflow or oversize the equipment.

Simple single zone systems serving a theater, an auditorium, or a gymnasium can be a problem, particularly if one air handler is used for the entire area. The wide fluctuation in load caused by the wide variation in the occupancy of these facilities leads to problems at part load conditions. In many cases, a single air handling unit sized for full occupancy can maintain space temperature setpoint with a supply air temperature that is within a degree or two of the space temperature when the facility is at minimum occupancy. This insures part load humidity problems.

Get the airflow right and full load humidity problems are less likely. Always consider what will happen to the supply air temperature and the resulting space humidity at part load conditions. Consider the following possible solutions to part load humidity problems when using single zone equipment:

Colder Supply Air – Design for colder supply air. Then at part load the air will be colder than it would otherwise be, more moisture will be removed from the air stream, space humidity at part load will be lower. (Designing for lower space relative humidity will require colder supply air.)

Variable Air Volume Single Zone System – the single zone cooling coil provides constant discharge air temperature while the fan speed is modulated based on space temperature. After the fan reaches minimum speed the supply air temperature is modulated by decreasing.

Return Air Bypass Single Zone System – Using face and bypass dampers, bypass return air (not mixed air) around the cooling coil as the space cooling load is satisfied while the cooling coil operates with full flow.

Multiple Single Zone Systems – Use more than one air handling system. As the cooling load falls shut down one or more units. This causes the remaining units to supply colder air to maintain the space temperature setpoint.

Multizone Systems:

As with single zone, accurate determination of the cooling loads and zone airflow leads to good humidity control at full load conditions.

During warm weather, many multizone systems are operated without heating water to the heating coil because the boiler is turned off. Then at part load, mixed air is essentially bypassed around the cooling coil through the hot deck. The moisture laden mixed air is then delivered to the space causing a rise in the space humidity.

Improved part load space humidity performance can be achieved by resetting the hot deck temperature upward during periods of high humidity. (Of course this requires operating the boiler during the warm weather months.)

A multizone system with individual heating coils in the individual zone ducts also offers a possible solution to the part load humidity problem by providing a means of reheat.

Carefully consider the part load space humidity before using a multizone system.

Dual Duct Systems:

These systems typically have a hot and cold deck and are similar to multizone systems. Instead of zone dampers, modulating dual duct mixing boxes mounted near the space combine the hot and cold air streams from separate ducts then deliver the mixture to the space. The part load humidity problems are the same as with the multizone.

Improved part load space humidity performance can be achieved by resetting the hot deck temperature upward during periods of high humidity. Of course this requires operating the boiler during the warm weather months.

A modified arrangement known as a Dew Point Dual Duct system could be employed for good humidity control. All of the mixed air in the air handler passes through the cooling coil. Then a portion of this air is split off and passes through the hot coil then to the hot duct. Both hot and cold air streams have the same low dew point temperature giving this arrangement its name.

Carefully consider the part load space humidity before using a dual duct system. The system may be more expensive than other alternatives due to the requirement for two supply main ducts. As with a variable air volume system, terminal boxes are required, and these create additional maintenance.

Variable Air Volume Systems:

Because a VAV air handler maintains cold discharge air, it automatically maintains reasonable space humidity and should be considered where applicable and when budget permits.

However, VAV systems are not a panacea. The valve, heating coil, controls, and often filter and fan inside every VAV box represent additional maintenance. The maintenance aggravation is amplified when the VAV boxes are not easily accessible.

Computer Room Units:

Oversized computer room units are common. Determining the cooling load by summing all the nameplate amp ratings of all the computer equipment will surely result in an oversized unit and cause inefficient operation. Space humidity may not be a problem

only because the computer room unit has reheat capability. The unit adds enough heat to make up for the excess in airflow. Size computer room units to accommodate the estimated heat release from the computer equipment; airflows will be decreased, the supply temperatures will be lower for a longer period of time, and the reheat will operate far less frequently. Always consider multiple computer room units to split the cooling load.

Fan Coil Systems:

Fan coils usually handle sensible loads but often fall short on the latent load.

Do not design fan coil units to handle outdoor air because the cooling coils are usually not deep enough, because cycling the coil flow insures periods when no moisture removal occurs, and because local exhaust systems can cause bypass of outdoor air around the cooling coil directly into the space.

In lieu of specifying the total coil load for fan coil units, specify the entering and leaving air conditions, and specify that these conditions must be met at all fan speeds. Where multi-speed fan coil units are used, schedule the maximum airflow at the high fan speed setting.

Fan coil units represent a great maintenance burden. The multiple cooling coils with multiple filters, multiple condensate pans, multiple potential leak sources, and multiple potential leak sources, and multiple potential locations for mold growth must be considered.

Fan coils shall be installed in a manner that will prevent water from dripping or splashing outside the drain pans. Require back splash panels to contain the splashing caused by drips from coil valves and uninsulated piping within the cabinet enclosure.

Direct Expansion (DX) Equipment:

Avoid the use of DX coils in air handlers with constant running fans that handle outdoor air. When the sensible load is satisfied and the compressor turns off, unconditioned outdoor air is then delivered to the space and any water on the wet cooling coil is evaporated into the supply air and also delivered to the space. The result is poor part load humidity control.

9. Condensate Leaks

Condensate drain pans and drain lines from air conditioning equipment must be designed to allow access for cleaning and flushing. Blockages in fan coil condensate lines are notorious for causing overflowing drain pans and wet floors, walls, and ceilings.

Improper trapping of condensate discharge in air handling units leads to water hold-up and overflow at the condensate drain pan.

Provide details of the condensate traps on the design drawings. Require adequate slope in two directions on condensate drain pans and drain lines (1/4 inch per foot). Make certain that the equipment curb or equipment frame affords ample elevation of the pan outlet connection above the floor or roof to accommodate the required trap dimensions and drain line slope.

10. Barracks

Barracks have historically had high humidity problems leading to mold growth in the living space.

In barracks, the outside air shall be treated (heated/cooled) by a separate dedicated air handling unit to a neutral temperature, or as necessary to handle the latent load, and ducted to each living/sleeping room.

ENERGY and FORCE PROTECTION (Each Facility)					
I/O POINTS		AI	AO	BI	BO
1	GAS METER (Sync with display) *	X			
2	STEAM METER (When specified) *	X			
3	BTU METER - Chill Water System	X			
4	BTU METER - Hot Water System	X			
5	AT/FP EMERGENCY STOP BUTTON			X	
6	AT/FP EMERGENCY STOP COMMAND				X
7	LOAD SHEDDING COMMAND				X
8	MAIN WATER METER *	X			
9	MAKEUP WATER METER - CHILL WATER	X			

* Connecting System per section 7.6.3.3

CHILLER CONTROLS (Air Cooled)					
I/O POINTS		AI	AO	BI	BO
1	CHILLER ENABLE/DISABLE				X
2	CHILLER STATUS			X	
3	ALARM (AUTO RESET)			X	
4	ALARM (MANUAL RESET)			X	
5	COMPRESSOR ALARM *			X	
6	DEMAND LIMIT %	X			
7	DEMAND LIMIT REMOTE SETPT		X		
8	CHWS TEMPERATURE SETPOINT	X			
9	CHWS REMOTE SETPOINT ADJ		X		
10	CHWS TEMPERATURE	X			
11	CHWR TEMPERATURE	X			
12	SUCTION PRESSURE *	X			
13	DISCHARGE PRESSURE *	X			
14	LOCAL / DDC SELECTOR SWITCH			X	
15	LOCAL ALARM RESET			X	
16	Glycol Pump Pkg Motor Run Status			X	

* Per compressor on multi compressor system

WATER TREATMENT (COOLING TOWER)					
I/O POINTS		AI	AO	BI	BO
1	pH	X			
2	CONDUCTIVITY (TDS)	X			
3	ALARM STATUS (GENERAL)			X	
4					

WATER TREATMENT (BOILER/STEAM GENERATOR)					
I/O POINTS		AI	AO	BI	BO
1	pH	X			
2	CONDUCTIVITY (TDS)	X			
3	CONDENSATE COND (TDS)			X	
4	ALARM STATUS (GENERAL)			X	

Legend: I = input O = output A = analog B = binary

CHILLER CONTROLS (Water Cooled)					
I/O POINTS		AI	AO	BI	BO
1	CHILLER ENABLE/DISABLE				X
2	CHILLER STATUS			X	
3	ALARM (AUTO RESET)			X	
4	ALARM (MANUAL RESET)			X	
5	COMPRESSOR ALARM *			X	
6	DEMAND LIMIT %	X			
7	DEMAND LIMIT REMOTE SETPT		X		
8	CHWS TEMPETURE SETPOINT	X			
9	CHWS REMOTE SETPOINT ADJ		X		
10	CHWS TEMPERATURE	X			
11	CHWR TEMPERATURE	X			
12	CONDENSER WATER SUPPLY	X			
13	CONDENSER WATER RETURN	X			
14	LOCAL / DDC SELECTOR SWITCH			X	
15	LOCAL ALARM RESET			X	
16	Glycol Pump PkgMotor Run Status			X	

* Per compressor on multi compressor system

COOLING TOWERS & FLUID COOLERS					
I/O POINTS		AI	AO	BI	BO
1	CHW SYS ENABLE/DISABLE				X
2	CONDENSER WATER SUPPLY	X			
3	CONDENSER WATER RETURN	X			
4	COND SUPPLY TEMP SETPT	X			
5	FAN LOW SPEED*				X
6	FAN HIGH SPEED*				X
7	FAN % SPEED (VFD)*		X		
8	FAN STATUS *			X	
9	FAN ALARM *			X	
10	BASIN WATER TEMPERATRE	X			
11	BASIN TEMP SETPT	X			
12	BASIN BYPASS VALVE		X		
13	HEAT TRACE ENABLE/DISABLE			X	
14	HEAT TRACE SYS ALARM			X	

* Per Fan

TERMINAL UNITS, VAV COOLING ONLY					
I/O POINTS		AI	AO	BI	BO
1	CONTROL MODE				X
2	SPACE TEMPERATURE (Deg F)	X			
3	COOLING SETPOINT (Deg F)	X			
4	HEATING SETPOINT (Deg F)	X			
5	LOCAL SETPOINT ADJUST	X			
6	AIR FLOW SETPOINT (cfm)	X			
7	AIR FLOW STATUS (cfm)	X			

Legend: I = input O = output A = analog B = binary

8	DAMPER		X		
9	AIR QUALITY SENSOR ^			X	
10	OCCUPANCY SENSOR *			X	

^ WHEN SHOWN ON PRINTS

* CONFERENCE ROOM UNITS

TERMINAL UNITS, VAV REHEAT					
I/O POINTS		AI	AO	BI	BO
1	CONTROL MODE				X
2	SPACE TEMPERATURE (Deg F)	X			
3	COOLING SETPOINT (Deg F)	X			
4	HEATING SETPOINT (Deg F)	X		X	
5	LOCAL SETPOINT ADJUST	X			
6	DISCHARGE AIR TEMP (Deg F)	X			
7	CONTROL VALVE		X		
8	AIR FLOW SETPOINT (cfm)	X			
9	AIR FLOW STATUS (cfm)	X			
10	DAMPER		X		
11	HOT WATER AVAIL/UNAVAIL			X	
12	AIR QUALITY SENSOR ^			X	
13	OCCUPANCY SENSOR *			X	

^ WHEN SHOWN ON PRINTS

* CONFERENCE ROOM UNITS

HIGH TEMP HOT WATER (HTHW)					
I/O POINTS		AI	AO	BI	BO
1	HOT WATER SYSTEM ENABLE			X	
2	SUMMER/WINTER			X	
3	OUTSIDE AIR TEMPERATURE	X			
4	HW SUPPLY TEMPERATURE	X			
5	HW RETURN TEMPERATURE	X			
6	HW SUPPLY TEMP SETPOINT		X		
7	HW SUPPLY TEMP HI ALARM			X	
8	HW SUPPLY TEMP LOW ALARM			X	
9	HTHW SUPPLY TEMPERATURE	X			
10	HTHW SUPPLY PRESSURE	X			
11	HTHW RETURN TEMPERATURE	X			
12	HTHW RETURN PRESSURE	X			
13	HTHW SUPPLY EMER-SHUTOFF				X
14	HTHW RETURN EMER-SHUTOFF				X
15	HX LOW SIDE PRESSURE SWITCH			X	
16	HX VENT LINE HI TEMP SWITCH			X	
17	MECH ROOM RELATIVE HUMIDITY			X	
18	HTHW EMER-SHUTOFF ACTIVE			X	

AIR CONDITIONING CONDENSER UNIT					
I/O POINTS		AI	AO	BI	BO
1	COOLING ENABLE/DISABLE				X

Legend: I = input O = output A = analog B = binary

2	SUMMER/WINTER			X	
3	DX STAGE COMMAND*				X
4	DX STATUS			X	
5	SUCTION PRESSURE *	X			
6	DISCHARGE PRESSURE *	X			
7	COMPRESSOR AMPERAGE*	X			
8	ALARM (AUTO RESET)			X	
9	ALARM (MANUAL RESET)			X	

* Per compressor on multi compressor system

HOT WATER TEMPERTURE CONTROL (STEAM)					
I/O POINTS		AI	AO	BI	BO
1	HOT WATER SYSTEM ENABLE				X
2	SUMMER/WINTER			X	
3	OUTSIDE AIR TEMPERATURE	X			
4	HW SUPPLY TEMPERATURE	X			
5	HW RETURN TEMPERATURE	X			
6	STEAM PRESSURE	X			
7	HW SUPPLY TEMP SETPOINT		X		
8	STEAM CONTROL VALVE		X		
9	HW SUPPLY TEMP HI ALARM			X	
10	HW SUPPLY TEMP LOW ALARM			X	
11	HW SUPPLY HI TEMP CUTOFF				X
12	LOCAL / DDC SELECTOR SWITCH			X	
13	LOCAL ALARM RESET			X	

AIR HANDLER WITH RETURN FAN					
I/O POINTS		AI	AO	BI	BO
1	SUPPLY DUCT STATIC PRESSURE	X			
2	SUPPLY AIR TEMPERATURE	X			
3	SUPPLY FAN START				X
4	SUPPLY FAN VFD		X		
5	SUPPLY FAN STATUS	X			
6	SUPPLY AIR SETPOINT	X			
7	COOLING COIL VALVE		X		
8	LOW TEMP CUTOFF			X	
9	HEATING COIL VALVE		X		
10	INTREGAL FACE & BYPASS		X		
11	MIXED AIR TEMPERATURE	X			
12	FILTER STATUS	X			
13	MINIMUM OUTSIDE AIR DAMPER		X		
14	MINIMUM OUTSIDE AIR (CFM)	X			
15	OUTSIDE AIR DAMPER		X		
16	OUTSIDE AIR TEMPERATURE *	X			
17	OUTSIDE AIR CO ₂	X			
18	RETURN AIR TEMPERATURE	X			

Legend: I = input O = output A = analog B = binary

19	RETURN AIR HUMIDITY	X			
20	RETURN AIR IAQ (CO ₂)	X			
21	RETURN FAN START				X
22	RETURN FAN VFD		X		
23	RETURN FAN STATUS			X	
24	SPACE STATIC PRESSURE	X			
25	SA HI STATIC PRESSURE CUTOUT			X	
26	EMERGENCY STOP BUTTON *				X
27	EMERGENCY STOP BUTTON			X	

* Only one required for all AHU's

AIR HANDLER WITH RELIEF FAN					
I/O POINTS		AI	AO	BI	BO
1	SUPPLY DUCT STATIC PRESSURE	X			
2	SUPPLY AIR TEMPERATURE	X			
3	SUPPLY FAN START				X
4	SUPPLY FAN VFD		X		
5	SUPPLY FAN STATUS		X		
6	SUPPLY AIR SETPOINT	X			
7	COOLING COIL VALVE		X		
8	LOW TEMP CUTOUT			X	
9	HEATING COIL VALVE		X		
10	INTREGAL FACE & BYPASS		X		
11	MIXED AIR TEMPERATURE	X			
12	FILTER STATUS	X			
13	MINIMUM OUTSIDE AIR DAMPER		X		
14	MINIMUM OUTSIDE AIR (CFM)	X			
15	OUTSIDE AIR DAMPER		X		
16	OUTSIDE AIR TEMPERATURE *	X			
17	OUTSIDE AIR CO ₂ *	X			
18	RETURN AIR TEMPERATURE	X			
19	RETURN AIR HUMIDITY	X			
20	RETURN AIR IAQ (CO ₂)	X			
21	RELIEF FAN START				X
22	RELIEF FAN VFD		X		
23	RELIEF FAN STATUS			X	
24	SPACE STATIC PRESSURE	X			
25	SA HI STATIC PRESSURE CUTOUT				X
26	ASSOC. EXHAUST FAN START				X
27	ASSOC. EXHAUST FAN STATUS			X	
28	EMERGENCY STOP BUTTON *				X
29	EMERGENCY STOP BUTTON			X	

* Only one required for all AHU's

COMPUTER ROOM AIR CONDITIONER (CRAC) MONITORING					
I/O POINTS		AI	AO	BI	BO
1	ROOM TEMPERATURE *	X			

Legend: I = input O = output A = analog B = binary

2	ROOM RELATIVE HUMIDITY*	X			
3	FAN STATUS*			X	
4	ALARM STATUS (GENERAL)*			X	

* ONLY IF NOT CAPTURED BY ANOTHER PROCESS REPORTING TO EMCS

EXHAUST FANS					
I/O POINTS		AI	AO	BI	BO
1	EXHAUST FAN START				X
2	EXHAUST FAN STATUS			X	

COMMUNICATION EQUIPMENT AND SERVER ROOMS					
I/O POINTS		AI	AO	BI	BO
1	ROOM TEMPERATURE*	X			
2	ROOM HI TEMP ALARM*			X	

* ONLY IF NOT CAPTURED BY ANOTHER PROCESS REPORTING TO EMCS

PUMP CONTROLS (NON FLOW CONTROL)					
I/O POINTS		AI	AO	BI	BO
1	LEAD ENABLE/DISABLE				X
2	LAG ENABLE/DISABLE				X
3	FAIL ENABLE/DISABLE				X
4	PUMP #1 STATUS *			X	
5	PUMP #2 STATUS *			X	
6	PUMP #1 ALARM			X	
7	PUMP #2 ALARM			X	
8	PUMP ALTERNATE (168hrs)			X	

* Per Pump

PUMP CONTROLS (FLOW CONTROL)					
I/O POINTS		AI	AO	BI	BO
1	LEAD ENABLE/DISABLE				X
2	LAG ENABLE/DISABLE				X
3	FAIL ENABLE/DISABLE				X
4	PUMP #1 STATUS *			X	
5	PUMP #2 STATUS *			X	
6	PUMP #1 ALARM			X	
7	PUMP #2 ALARM			X	
8	WATER FLOW STATUS			X	
9	WATER FLOW SETPOINT	X			
10	WF CONTROL VAVLE		X		

*Per Pump

BOILER / STEAM GENERATOR					
I/O POINTS		AI	AO	BI	BO
1	COMBUSTION AIR DAMPERS			X	
2	STEAM PRESSURE	X			

Legend: I = input O = output A = analog B = binary

3	LEAD ENABLE/DISABLE				X
4	LAG ENABLE/DISABLE				X
5	FAIL ENABLE/DISABLE				X
6	FEED WATER PUMP STATUS *			X	
7	FEED WATER PUMP ALARM *			X	
8	LOW WATER ALARM			X	
9	HIGH WATER ALARM			X	
10	WATER FLOW STATUS			X	
11	HOT WATER SETPOINT	X			
12	HOT WATER SUPPLY TEMP	X			
13	HOT WATER RETURN TEMP	X			
14	HW SUPPLY TEMP ALARM (LOW)			X	
15	HW SUPPLY TEMP ALARM (HIGH)			X	
16	BLOWDOWN VALVE				X
17	BLOWDOWN VALVE OPEN ALARM			X	

* Per device if multiple system

Fire Protection / Life Safety / Accessibility Code Review

Form version 23 dated 4 February 2014

Applicability: A Fire Protection/Life Safety/Accessibility Code Review shall be developed and included in ALL project submittals for government review and comment, including unoccupied facilities. Also Fire Protection/Life Safety/Accessibility Floor Plan(s) drawings shall be developed and included in ALL project submittals for government review and comment.

Instructions: The Designer of Record (DOR) shall use this form to record Fire Protection, Life Safety and Accessibility features for all building projects, including unoccupied facilities. The form shall be edited, adding and subtracting criteria to include specific and actual project requirements. The DOR must also sign the form where indicated. The form shall be provided in the Design Analysis and on a Code Review drawing. Fire Protection/Life Safety/Accessibility drawings shall be developed, graphically showing all features of fire protection/ life safety/accessibility. These drawings shall be indicated as "For Reference Only".

Note: The use of "equivalencies" are not permitted without approval from the Army or Air Force AHJ. If equivalencies are pursued, additional review and approval time shall be provided in the project delivery schedule (min 4-6 weeks). Performance-based fire protection options will not be considered.

Project Name and Location

1. PROJECT'S APPLIED CODES & STANDARDS

- a. UFC 1-200-01: *General Building Requirements*, Change 1, 1 July 2013
- b. UFC 3-600-01: *Design: Fire Protection Engineering for Facilities*, with Change 3, 1 March 2013
- c. UFC 4-021-01: *Design and O&M: Mass Notification Systems*, with Change 1, January 2010
- d. IBC 2012: *International Building Code* for fire resistance requirements, allowable floor area, building height limits, and building separation distance, except as modified by UFC 3-600-01
- e. NFPA 1, 2012: *Fire Code*, for determining vehicle access requirements
- f. NFPA 101, 2012: *Life Safety Code*, for building egress and life safety except as modified in UFC 3-600-01
- g. NFPA 10, 2013: *Standard for Portable Fire Extinguishers*
- h. NFPA 13, 2013: *Standard for Installation of Sprinkler Systems*, minimum requirements for design and installation of automatic fire sprinkler systems and exposure protection
- i. NFPA 20, 2013: *Standard for the Installation of Stationary Pumps for Fire Protection*, for construction & installation reqmts for fire pumps
- j. NFPA 30, 2012: *Flammable and Combustible Liquids Code*, for construction requirements and fire resistance ratings for liquid storage areas
- k. NFPA 30A, 2012: *Code for Motor Fuel Dispensing Facilities and Repair Garages*, for occupancy classification, construction requirements and means of egress for repair garages and organizational maintenance shops
- l. NFPA 70, 2014: *National Electrical Code (NEC)* - Article 500 Hazardous Locations & Article 511 Commercial Garages, Repair & Storage
- m. NFPA 80, 2013: *Standard for Fire Doors and Other Opening Protectives*
- n. NFPA 72, 2013: *National Fire Alarm and Signaling Code*
- o. NFPA 90A, 2012: *Standard Installation of Air Conditioning & Ventilation Systems*, for protection of openings, shafts, fire dampers, smoke dampers, penetrations and fan control
- p. NFPA 96, 2014: *Standard for Ventilation Control and Fire Protection of Commercial Cooking*
- q. NFPA 291, 2013: *Recommended Practice for Fire Flow Testing and Marking of Hydrants*
- r. ASME A17.1, 2013: *Safety Code for Elevators and Escalators*
- s. ABA (Architectural Barriers Act) *Accessibility Standards for DoD Facilities, Chapters 1-10, adopted by DOD by Memorandum dated October 2008*
- t. *Factory Mutual Global Property Loss Prevention Data Sheet 3-26, dtd July 2011*

1. BUILDING CODE REQUIREMENTS:

a. Occupancy Classification:

IBC Chapter 3

Exception: Use NFPA 30A for Repair Garage

Indicate project's occupancy classification information based on IBC for building code requirements.

b. Construction Type:

IBC Chapter 6

Indicate project's building code (IBC) construction type.

c. Mixed Use & Occupancy Separations

IBC Section 508

Indicate specific project's method for mixed use or occupancy separation. Include equations proving the area allowances for separated occupancy per 508.3.3.2 if it applies. For example:

$$\frac{S-1}{65,625sf} + \frac{H-2}{26,250sf} = .347 < 1 \text{ (okay)}$$

d. Area Limitations / Modifications:

IBC Section 503, 506, 507

Indicate specific project's area limitations, Table 503. Describe area modifications taken. Include equations proving allowable area increases using frontage and automatic sprinkler factors. For example:

Area Determination

$$A_t = 16000 > \text{actual} = 9503$$

$I_s = 2$ for sprinkler increase

$$I_f = 0$$

$$A_a = 16000 + [16000(0)] + [16000(2)] = 48000 > \text{actual } 27843 \text{ okay}$$

e. Height Limitations:

IBC: Table 503 and Section 504.2

Indicate specific project's height limitations, providing maximum height allowed and actual height per building height definition in Section 502.

f. Vertical Enclosures, Continuity & Protection:

IBC: Section 708

NFPA 101: 7.2.2, 8.6

NFPA 90A: 4.3.1.2, 5.3.4

Indicate fire protection provisions for stair enclosures, utility shafts, elevators, laundry chutes, etc. Describe area of refuge requirement for stairs, if any. Indicate vertical enclosure requirements & provisions based on number of bldg stories for stairways, elevator hoistways, light shafts, bldg expansion joints, etc. List required fire resistance ratings of shafts, for example: 2-Story Shaft Enclosures - () hour rating; 3-Story Laundry Chute Enclosure - () hour rating.

g. Opening Protectives & Thru-Penetrations

NFPA 101: 8.3 thru 8.6

NFPA 90A

NFPA 80

Indicate requirements & provisions for fire barriers, smoke partitions, smoke barriers, vertical openings, and special hazard protection.

h. Horizontal Assemblies:

IBC: Section 712

Indicate required horizontal separation requirement and provision.

i. Fire Resistive Requirements:

IBC: Table 601 and Section 602

Indicate requirements based on construction type:

Primary Structural Frame - () hour rating

Exterior Bearing Walls - () hour rating

Interior Bearing Walls - () hour rating

Exterior Nonbearing partitions - () hour rating

Interior Nonbearing partitions - () hour rating

Floor Construction & Secondary Members - () hour rating

Roof Construction & Secondary Members - () hour rating

j. Enclosure Protection:

NFPA 101: Specific Occupancy Chapters

ASME A17.1

Indicate enclosure protection requirement for specific spaces and what is actually provided, example:

Mechanical Rm requires 1 Hr or sprinklered - 1 Hr partition and sprinkler provided.

Janitor Closet requires 1 Hr or sprinklered - Sprinkler provided.

k. Fire Protection System:

UFC 3-600-01: Chapters 4 & 6

FM Global Loss Prevention Data Sheet 3-26

UFC 3-600-01: Appendix B

Determine the requirement for fire protection systems, stating which systems are required and criteria to which they are designed.

Indicate the hazard category based on occupancy for various rooms, using UFC 3-600-01, Appendix "B". Consider classifying the entire bldg and noting exceptions for differing rooms. For example, The entire building is HC-1 except mechanical, electrical and storage rooms are HC-2, ...etc.

UFC 3-600-01: 4-2 and FM Global Loss Prevention Data Sheet 3-26, except as modified in Chapter 6 of UFC for specific facility types

For each occupancy hazard category based on Tables 2, 2a, 3 and 4 from FM data sheet 3-26 for non-storage applications, indicate Sprinkler Design Density, Sprinkler Design Area, Water Demand for Hose Streams, providing supply pressure and source requirements

UFC 3-600-01: Chapter 4

NFPA 13

Coverage per sprinkler must be in accordance with NFPA 13, not exceeding 225 sf for light hazard or 130 sf for ordinary hazard. Extended coverage heads are not permitted.

l. Available Water Supply Testing

UFC 3-600-01: 4-1.3

NFPA 291

Provide results of water flow tests per the UFC requiring a fire protection engineer or engineer experienced in water flow testing perform or witness the flow testing iaw NFPA 291. Water supply data shall show available water supply, static pressure, & residual pressure at flow. Based on this data & estimated flow & pressure required for the bldg sprinkler system(s), determine the need for a fire pump. Indicate test & flow hydrant locations, elevations, & water flow data on contract drgs.

m. Water Storage Tank Requirements

UFC 3-600-01: Chapter 3

If required, provide water storage requirements including capacity & type of storage tank used.

n. Backflow Preventer & Testing

NFPA 13: 8.16.4.6.1

UFC 3-600-01: 4-2.3.5

Provide backflow preventor valves as required by local authority or water purveyor. On contract drawings show and provide test piping and valve located downstream of the backflow preventer for flow testing the backflow preventer at full system demand flow. Route the discharge to an appropriate location outside the building. Minimum pressure drop across backflow preventer is 12 psi for hydraulic calculations.

o. Fire Pump(s)
UFC 3-600-01: Chapter 3
NFPA 20

Provide fire pump(s) flow and pressure requirements, locations, and construction enclosure.

2. LIFE SAFETY REQUIREMENTS:

a. Classification of Occupancy:
NFPA 101: Ch 6
NFPA 30A for Repair Garage

Indicate project's occupancy classification information based on NFPA 101 for life safety code requirements.

b. Occupant Load:
NFPA 101: 7.3.1.2 & Chapters 12-42

*Indicate total occupant load, showing occupant load factors and subtotals of various occupancies for each floor, for example:
Actual floor area Business: 5,626 GSF / 100 GSF = 56.37 ~ 57
Actual floor area Assembly: 1,920 NSF / 15 NSF = 128.002 ~ 129
Total Floor Maximum Occupancy: 186*

c. Capacity of Means of Egress:
NFPA 101: 7.3.3 & Chapters 12-42

Indicate egress capacity for components of all means of egress including stairs, corridors, ramps, and doors. Include total egress capacity needed.

d. Number of Exits:
NFPA 101: 7.4 & Chapters 12-42

Indicate number of exits required based on egress capacity needed. Indicate number of exits provided.

e. Arrangement of Means of Egress:
NFPA 101: 7.5 & Chapters 12-42

Indicate requirements for means of egress arrangement, including project's provisions to comply.

f. Travel Distance to Exits:
NFPA 101: 7.6 & Chapters 12-42

Indicate travel distance requirements and project's provisions to comply using worst case distance. Include common path, dead end, and travel distance limits for each occupancy.

g. Illumination of Means of Egress:
NFPA 101: 7.8 & Chapters 12-42

Indicate required and provided provisions for means of egress illumination.

h. Emergency Lighting:
NFPA 101: 7.9 & Chapters 12-42

Indicate required and provided provisions for emergency lighting.

i. Marking of Means of Egress:
NFPA 101: 7.10 & Chapters 12-42

Indicate required and provided provisions for marking of egress lighting.

j. Interior Finish Classification Limits:
NFPA 101: Table A.10.2.2

Indicate required and provided provisions for interior finish classification limitations.

k. Detection, Alarm, & Communications:
UFC 3-600-01, Section 5 & 6
NFPA 101: 9.6 & Chapters 12-42

Indicate requirements for manual alarm initiation, automatic detection, and alarm notification. Include location to which notification is sent.

l. Portable Fire Extinguishers:
NFPA 101: 9.7.4
NFPA 10

Indicate requirements for manual extinguishing equipment and provisions provided.

m. Corridors:
NFPA 101: Chapters 12-42

Indicate requirement and provisions for corridor protection including any fire and smoke ratings and door ratings.

n. Fire Dampers:
NFPA 90A: 5.3.1, 5.4.1 & 5.4.2

Fire dampers shall be dynamic type, rated for 3,000 ft/min or greater. Edit the following or insert other requirements for this project:

Fire rated dampers shall be installed in ducts passing through partitions or walls having a fire resistance rating of 2 hours or greater.

Fire dampers shall be installed in ducts passing through fire resistance rated shafts.

Fire dampers shall be installed in air transfer openings in fire resistance rated partitions.

Fire dampers shall be installed in ducts passing through floors except where the floor penetration is within a fire rated shaft.

o. Smoke Dampers:
IBC: Section 716
NFPA 90A: 4.3.10.2, 5.3.5.1

Indicate requirement & project's provision for dynamic smoke dampers. Provide isolation smoke damper when air handling equipment systems have a capacity greater than 15,000 cfm to isolate the air-handling equipment, including filters, from the remainder of the system on both the building supply and return sides, in order to restrict the circulation of smoke.

p. Duct Smoke Detectors

NFPA 90A: 6.4.2.1

Indicate type of duct smoke detectors required & provided, for example: Duct smoke detectors installed downstream of the air filters and ahead of any branch connections in air supply systems having a capacity greater than 2,000 cfm.

q. Elevators

UFC 3-600-01: 6-30

IBC Chapter 30

ASME A17.1

NFPA 13

Indicate elevator type, construction, detection systems, and sprinkler requirements & provisions, for example: A holeless hydraulic type elevator is provided with 1 hr rated shaft walls, sprinklers, smoke detectors, flow switches and necessary appurtenances for elevator machine room, top and pit of hoistway, see figure 6-11, UFC 3-600-01. See contract drawings for figure for type of elevator used. The elevator is not considered an egress component. Hoistway vent and elevator lobby not required for shaft penetrating not more than 3 stories.

r. Roof Access:

UFC 3-600-01: 2-9

IBC Chapter 1009.13

Indicate requirements & provisions for roof access.

s. Hazardous Locations in Commercial Garages

NFPA 70: NEC Articles 500 & 511

Indicate class and division of hazardous locations within the work bays, pits, and adjacent rooms. Indicate methods used to unclassify areas adjacent to classified locations such as corridors, offices, stockrooms, mechanical rooms, and electrical rooms. Indicate use of positive pressure or cut-off wall (to include door seals) to declassify areas adjacent to hazardous work areas.

t. Fire Dept Vehicle Access

UFC 3-600-01: 2-10

NFPA 1: 3.5

Indicate requirements and provisions for vehicle access to the building, for example: All weather ground access provided with widened/thickened sidewalks at 30 ft from the bldg on two sides of the two story bldg. Removable bollards are provided at the AFTP setback to the sidewalk points.

u. Fire Hydrant Installation

UFC 3-600-01: 3-7.3

Indicate hydrant installation requirements and provisions including spacing based on bldg type.

v. Kitchen Cooking Exhaust Equipment

NFPA 101: 9.2.3, Chapters 12-42

NFPA 96

Indicate provision for kitchen cooking equipment in the project. Indicate extinguishing system required and provided. On contract drawings, show all interlocks with manual release switches, fuel shutoff valves, electrical shunt trips, exhaust fans, and building alarms on the contract drawings.

3. MASS NOTIFICATION:

UFC 4-021-01

Indicate mass notification system requirements and provisions including type of base-wide mass notification / communication system.

Note: Air Force and Army use white/clear strobe marked "FIRE" for the FA and amber strobe marked "ALERT" for the MN. Navy and Marine Corps use white/clear strobe marked "ALERT" rather than "FIRE". The Navy uses a text sign showing "EVACUATE" when the fire alarm is activated or "ANNOUNCEMENT" when the mass notification is activated. See UFC paragraph 4-3.4.2 for more information.

4. ACCESSIBILITY REQUIREMENTS:

ABA Chapters 1-10

Indicate accessibility requirements for the project, for example: "Facility shall be completely accessible in accordance with ABA. Fire alarm annunciators shall be in accordance with ABA." or "Facility is considered as being for able-bodied persons only, therefore, is not required to be fully accessible".

CERTIFICATION OF FIRE PROTECTION & LIFE SAFETY CODE REQUIREMENTS

Preparers of this document certify the accuracy and completeness of the Fire Protection and Life Safety features for this project indicated with the attached, completed signature forms.

**Architect-Engineer
Certification of Fire Protection / Life Safety / Accessibility Code Requirements**

Insert Project Name and Location

**Preparers of this document certify the accuracy and completeness of the
fire protection, life safety, and accessibility features of this project.**

Fire Protection Engineer of Record:

Signature

Date

OR

Architect of Record:

Signature

Date

Mechanical Engineer of Record:

Signature

Date

Electrical Engineer of Record:

Signature

Date

**88 CEG/CEN IN-HOUSE DESIGN
FIRE PROTECTION / LIFE SAFETY / ACCESSIBILITY CODE REVIEW
PRELIMINARY OR INTERIM DESIGN**

Insert Project Name and Location

**The project specific Fire Protection / Life Safety / Accessibility Code Submittal has been completed and is attached.
The life safety / fire protection / accessibility plans, code review, and related design analysis documentation have been checked and
approved by the following in-house review team:**

Project Design Team Leader:

Signature

Date

Architectural Fire Team Member:

Signature

Date

Mechanical Fire Team Member:

Signature

Date

Electrical Fire Team Member:

Signature

Date

88 CEG/CEN IN-HOUSE DESIGN
FIRE PROTECTION / LIFE SAFETY / ACCESSIBILITY CODE REVIEW
FINAL DESIGN

Insert Project Name and Location

The project specific Fire Protection / Life Safety / Accessibility Code Submittal has been completed and is attached.
The construction contract plans, specifications, and related design analysis documentation have been checked and approved for by the
following in-house review team:

Project Design Team Leader:

Signature

Date

Architectural Fire Team Member:

Signature

Date

Mechanical Fire Team Member:

Signature

Date

Electrical Fire Team Member:

Signature

Date