FTFA 23-MM06
Addition and Renovation
B521
Eglin AFB, Florida

Specifications
Volume 2 of 2

13 March 2024

65% Design Submittal

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WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2021) Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1013	(2021) Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies
ASSE 1015	(2021) Performance Requirements for Double Check Backflow Prevention Assemblies

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA M14	(2015) Manual: Recommended Practice for Backflow Prevention and Cross-Connection Control

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M	(1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A135/A135M	(2021) Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel

	Hardware
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INTELLIGENCE COMMUNITY STANDARD (ICS)

ICS 705-1	(2010) Physical and Technical Security Standard for Sensitive Compartmented Information Facilities

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71	(2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2022; ERTA 1 2021) Standard for the Installation of Sprinkler Systems
NFPA 13R	(2022) Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies
NFPA 24	(2022) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 101	(2021) Life Safety Code
NFPA 291	(2022) Recommended Practice for Fire Flow Testing and Marking of Hydrants
NFPA 1963	(2019) Standard for Fire Hose Connections

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(2012) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01	(2016; with Change 6, 2021) Fire Protection Engineering for Facilities

UNDERWRITERS LABORATORIES (UL)

UL 193	(2016) UL Standard for Safety Alarm Valves for Fire-Protection Service
UL 199	(2020) UL Standard for Safety Automatic Sprinklers for Fire-Protection Service
UL 312	(2010; Reprint Mar 2018) UL Standard for Safety Check Valves for Fire-Protection Service
UL 405	(2013; Bul. 2020) UL Standard for Safety Fire Department Connection Devices
UL 668	(2004; Reprint Jul 2016) UL Standard for Safety Hose Valves for Fire-Protection Service
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

Provide wet pipe sprinkler system(s) in areas indicated on the drawings . Except as modified herein, the system must meet the requirements of NFPA 13 and UFC 3-600-01. Pipe sizes which are not indicated on the Contract drawings must be determined by hydraulic calculations.

1.2.1 Hydraulic Design

1.2.1.1 Basis for Calculations

A waterflow test was performed on 22 February 2024 at Building 521 and resulted in a static pressure of 58 psi with a residual pressure of 41 psi while flowing 1500 gpm. Perform a fire hydrant flow test prior to shop drawing submittal in accordance with NFPA 291. Results must include hydrant elevations relative to the building and hydrant number/identifiers for the tested hydrants, including which were flowed, which had a gauge. This information must be presented in a tabular form if multiple hydrants were flowed. The results must be included with the hydraulic calculations. Hydraulic calculations must be based upon the Hazen-Williams formula with a "C" value noted in NFPA 13 for piping. The minimum residual pressure in a service lateral (lead-in) at the design flow rate must be 20 psi at the inlet to the backflow preventer.

1.2.1.2 Hydraulic Calculations

a. Water supply curves and system requirements must be plotted on semi-logarithmic graph (N^1.85) paper so as to present a summary of the complete hydraulic calculation.

b. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, minimum discharge pressures and minimum flows. Elevations of hydraulic reference points (nodes) must be indicated.

c. Documentation must identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe.

d. Where the sprinkler system is supplied by interconnected risers, the sprinkler system must be hydraulically calculated using the hydraulically most demanding single riser. The calculations must not assume the simultaneous use of more than one riser.

e. All calculations must include the backflow preventer manufacturer's stated friction loss at the design flow or 8 psi for double check backflow preventer, whichever is greater.

f. All calculations must be performed back to the actual location of the flow test, taking into account the direction of flow in the service main at the test location.

g. For gridded systems, calculations must show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. A flow diagram indicating the quantity and direction of flows must be included.

1.2.1.3 Design Criteria

Hydraulically design the system to discharge a minimum density as indicated on the drawings. Hydraulic calculations must be in accordance with the Area/Density Method of NFPA 13. Add an allowance for exterior hose streams of 250 gpm to the sprinkler system demand at the fire hydrant shown on the drawings closest to the point where the water service enters the building .

1.2.2 Sprinkler Coverage

Sprinklers must be uniformly spaced on branch lines. Provide coverage throughout 100 percent of the area noted on the Contract drawings. This includes, but is not limited to, telephone rooms, electrical equipment rooms (regardless of the fire resistance rating of the enclosure), boiler rooms, switchgear rooms, transformer rooms, attached electrical vaults and other electrical and mechanical spaces. Coverage per sprinkler must be in accordance with NFPA 13. Provide sprinklers below all obstructions in accordance with NFPA 13. Exceptions are as follows:

a. Sprinklers may be omitted from small rooms which are exempted for specific occupancies in accordance with NFPA 101.

b. Facilities that are designed in accordance with NFPA 13R.

1.2.3 Qualified Fire Protection Engineer (QFPE)

An individual who is a licensed professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) and has relevant fire protection engineering experience. Services of the QFPE must include:

a. Reviewing SD-02, SD-03, and SD-05 submittal packages for completeness and compliance with the provisions of this specification. Working (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of, the QFPE. The QFPE must affix their professional engineering stamp with signature to the shop drawings, calculations, and material data sheets, indicating approval prior to submitting the shop drawings to the DFPE.

b. Provide a letter documenting that the SD-02, SD-03, and SD-05 submittal package has been reviewed and noting all outstanding comments.

c. Performing in-progress construction surveillance prior to installation of ceilings (rough-in inspection).

d. Witnessing pre-Government and final Government functional performance testing and performing a final installation review.

e. Signing applicable certificates under SD-07.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Partial submittals and submittals not fully complying with NFPA 13 and this specification section must be returned disapproved without review. SD-02, SD-03 and SD-05 must be submitted simultaneously.

Shop drawings (SD-02), product data (SD-03) and calculations (SD-05) must be prepared by the designer and combined and submitted as one complete package. The QFPE must review the SD-02/SD-03/SD-05 submittal package for completeness and compliance with the Contract provisions prior to submission to the Government. The QFPE must provide a Letter of Confirmation that they have reviewed the submittal package for compliance with the contract provisions. This letter must include their professional engineer stamp and signature. Partial submittals and submittals not reviewed by the QFPE must be returned disapproved without review.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualified Fire Protection Engineer (QFPE); G

Sprinkler System Designer; G

Sprinkler System Installer; G

SD-02 Shop Drawings

Shop Drawing; G

SD-03 Product Data

Fittings; G

Valves, including gate, check, butterfly, and globe; G

Alarm Valves; G

Relief Valves; G

Sprinklers; G

Pipe Hangers and Supports; G

Sprinkler Alarm Switch; G

Valve Supervisory (Tamper) Switch; G

Fire Department Connection; G

Backflow Prevention Assembly; G

Air Vent; G

Hose Valve; GNameplates; G

SD-05 Design Data

Hydraulic Calculations; G

SD-06 Test Reports

Test Procedures; G

SD-07 Certificates

Verification of Compliant Installation; G

Request for Government Final Test; G

SD-10 Operation and Maintenance Data

Operating and Maintenance (O&M) Instructions; G

Spare Parts Data; G

SD-11 Closeout Submittals

As-built drawings

1.4 QUALITY ASSURANCE

1.4.1 Preconstruction Submittals

Within 36 days of contract award but no less than 14 days prior to commencing work on site, the prime Contractor must submit the following for review and approval. SD-02, SD-03 and SD-05 submittals received prior to the review and approval of the qualifications will be returned Disapproved Without Review.

1.4.1.1 Shop Drawing

Three copies of the shop drawings, no later than 28 days prior to the start of system installation. Working drawings conforming to the requirements prescribed in NFPA 13 and must be no smaller than the Contract Drawings. Each set of drawings must include the following:

a. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.

b. Floor plans drawn to a scale not less than 1/8-inch equals 1-foot clearly showing locations of devices, equipment, risers, and other details required to clearly describe the proposed arrangement.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross mains and branch lines to finished floor and roof or ceiling. A detail must show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross main pipe routing, elevation of each typical sprinkler above finished floor and elevation of "cloud" or false ceilings in relation to the building ceilings.

e. Plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance.

f. Riser layout drawings drawn to a scale of not less than 1/2-inch equals 1-foot to show details of each system component, clearances between each other and from other equipment and construction in the room.

g. Details of each type of riser assembly, pipe hanger, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring. The dimension from the edge of vertical piping to the nearest adjacent wall(s) must be indicated on the drawings when vertical piping is located in stairs or other portions of the means of egress.

h. Details of each type of pipe hanger and related components.

1.4.1.2 Product Data

Three copies of annotated catalog data to show the specific model, type, and size of each item. Catalog cuts must also indicate the NRTL listing. The data must be highlighted to show model, size, options, and other pertinent information, that are intended for consideration. Data must be adequate to demonstrate compliance with all contract requirements. Product data for all equipment must be combined into a single submittal.

1.4.1.3 Hydraulic Calculations

Calculations must be as outlined in NFPA 13 except that calculations must be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings.

1.4.1.4 Operating and Maintenance (O&M) Instructions

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA as supplemented and modified by this specification section.

Provide six manuals and one pdf version on electronic media. The manuals must include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment.

Submit spare parts data for each different item of material and equipment specified. The data must include a complete list of parts and supplies, and a list of parts recommended by the manufacturer to be replaced after 1-year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

1.4.2 Qualifications

1.4.2.1 Sprinkler System Designer

The sprinkler system designer must be certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Water-Based Systems Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7.

1.4.2.2 Sprinkler System Installer

The sprinkler system installer must be regularly engaged in the installation of the type and complexity of system specified in the contract documents, and must have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.3 Regulatory Requirements

Equipment and material must be listed or approved. Listed or approved, as used in this Section, means listed, labeled or approved by a Nationally Recognized Testing Laboratory (NRTL) such as UL Fire Prot Dir or FM APP GUIDE. The omission of these terms under the description of an item or equipment described must not be construed as waiving this requirement. All listings or approvals by testing laboratories must be from an existing ANSI or UL published standard. The recommended practices stated in the manufacturer's literature or documentation are mandatory requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. All pipes must be either capped or plugged until installed.

1.6 EXTRA MATERIALS

Spare sprinklers and wrench(es) must be provided as spare parts in accordance with NFPA 13.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Provide materials, equipment, and devices listed for fire protection service when so required by NFPA 13 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for a classification of material. Material and equipment must be standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid.

2.1.2 Nameplates

Major components of equipment must have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new name plate permanently affixed to the item or equipment. Nameplates must be etched metal or plastic, permanently attached by screws to control units, panels or adjacent walls.

2.1.3 Identification and Marking

Pipe and fitting markings must include name or identifying symbol of manufacturer and nominal size. Pipe must be marked with ASTM designation. Valves and equipment markings must have name or identifying symbol of manufacturer, specific model number, nominal size, name of device, arrow indicating direction of flow, and position of installation (horizontal or vertical), except if valve can be installed in either position. Markings must be included on the body casting or on an etched or stamped metal nameplate permanently on the valve or cover plate.

2.1.4 Pressure Ratings

Valves, fittings, couplings, alarm switches, and similar devices must be rated for the maximum working pressures that can be experienced in the system, but in no case less than 175 psi.

2.2 ABOVEGROUND PIPING COMPONENTS

2.2.1 Steel Piping Components

2.2.1.1 Steel Pipe

Except as modified herein, steel pipe must be black as permitted by NFPA 13 and conform to the applicable provisions of ASTM A53/A53M, ASTM A135/A135M or ASTM A153/A153M.

Steel pipe must be Schedule 40 only.

2.2.1.2 Fittings

Fittings must be welded, threaded, or grooved-end type. Threaded fittings must be cast-iron conforming to ASME B16.4, malleable-iron conforming to ASME B16.3 or ductile-iron conforming to ASTM A536. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe, steel press fittings and field welded fittings are not permitted. Fittings, mechanical couplings, and rubber gaskets must be supplied by the same manufacturer. Threaded fittings must use Teflon tape or manufacturer's approved joint compound. Reducing couplings are not permitted except as allowed by NFPA 13.

2.2.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings must be designed for not less than 175 psi service and the product of the same manufacturer. Field welded fittings must not be used. Fitting and coupling housing must be malleable-iron conforming to ASTM A47/A47M, Grade 32510; ductile-iron conforming to ASTM A536, Grade 65-45-12. Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 2 inches and larger. Gasket must be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts must be heat-treated steel conforming to ASTM A183 and must be cadmium-plated or zinc-electroplated.

2.2.1.4 Flanges

Flanges must conform to NFPA 13 and ASME B16.1. Gaskets must be non-asbestos compressed material in accordance with ASME B16.21, 1/16-inch thick, and full face or self-centering flat ring type.

2.2.2 Pipe Hangers and Supports

Provide galvanized pipe hangersand supports in accordance with NFPA 13.

2.2.3 Valves

Provide valves of types approved for fire service. Valves must open by counterclockwise rotation.

2.2.3.1 Control Valve

Manually operated sprinkler control/gate valve must be outside stem and yoke (OS&Y) type and must be listed.

2.2.3.2 Check Valves

Check valves must comply with UL 312. Check valves 4 inches and larger must be of the swing type, have a clear waterway and meet the requirements of MSS SP-71, for Type 3 or 4. Inspection plate must be provided on valves larger than 6 inches.

2.2.3.3 Hose Valve

Valve must comply with UL 668.

2.2.4 Alarm Valves

Provide variable pressure type alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, and main drain, and other components as required for a fully operational system. Alarm valves must comply with UL 193.

2.3 ALARM INITIATING AND SUPERVISORY DEVICES

2.3.1 Sprinkler Alarm Switch

Vane or pressure-type flow switch(es). Connection of switch must be by the fire alarm installer. Vane type alarm actuating devices must have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and must instantly recycle.

2.3.2 Valve Supervisory (Tamper) Switch

Switch must be integral to the control valve or suitable for mounting to the type of control valve to be supervised open. The switch must be tamper resistant and contain SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.4 BACKFLOW PREVENTION ASSEMBLY

Double-check valve assembly backflow preventer complying with ASSE 1013, ASSE 1015 and AWWA M14. Each check valve must have a drain. Backflow prevention assemblies must have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR List" and be listed for fire protection use. Listing of the specific make, model, design, and size in the FCCCHR List is acceptable as the required documentation.

2.4.1 Backflow Preventer Test Connection

Test connection must consist of a series of listed hose valves with 2 1/2-inch National Standard male hose threads with cap and chain.

2.5 FIRE DEPARTMENT CONNECTION

Fire department connection must be projecting type with cast-brass body, matching wall escutcheon lettered "Auto Spkr" with a polished-brass finish. The connection must have individual self-closing clappers, caps with drip drains and chains. Female inlets must have 2 1/2-inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963. Comply with UL 405.

2.6 SPRINKLERS

Sprinklers must comply with UL 199 and NFPA 13. Sprinklers with internal O-rings are not acceptable. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters must have temperature classification in accordance with NFPA 13. Extended coverage sprinklers are permitted for loading docks, residential occupancies and high-piled storage applications only.

2.6.1 Pendent Sprinkler

Pendent sprinkler must be quick-response type with nominal K-factor of 5.6 for light hazard and 8.0 for ordinary hazard. Pendent sprinklers must have a polished chrome finish. Assembly must include an integral escutcheon.

2.6.2 Upright Sprinkler

Upright sprinkler must be brass quick-response type and have a nominal K-factor of 5.6 for light hazard areas and 8.0 for ordinary hazard areas..

2.6.3 Concealed Sprinkler

Concealed sprinkler must be chrome-plated quick-response type and have a nominal K-factor of 5.6. Coverplate must be chrome.

2.6.4 Dry Sprinkler Assembly

Dry sprinkler assembly must be of the sidewall type as indicated. Assembly must include an integral escutcheon. Maximum length must not exceed maximum indicated in its listing. Sprinkler must have a polished chrome finish.

2.7 ACCESSORIES

2.7.1 Sprinkler Cabinet

Provide spare sprinklers in accordance with NFPA 13 and must be placed in a suitable metal or plastic cabinet of sufficient size to accommodate all the spare sprinklers and wrenches in designated locations. Spare sprinklers must be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed as required by NFPA 13. At least one wrench of each type required must be provided.

2.7.2 Pendent Sprinkler Escutcheon

Escutcheon must be one-piece metallic type with a depth of less than 3/4-inch and suitable for installation on pendent sprinklers. The escutcheon must have a factory finish that matches the pendent sprinkler.

2.7.3 Pipe Escutcheon

Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

2.7.4 Sprinkler Guard

Listed guard must be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards must be provided on sprinklers located in commuications, mechanical, janitor, and closet rooms.

2.7.5 Relief Valve

Relief valves must be listed and installed at the riser in accordance with NFPA 13.

2.7.6 Air Vent

Remote air vents must be of the manual type and piped to drain to the building exterior. Air vent at top of the fire riser shall be automatic type and shall be piped to drain to the building exterior.

2.7.7 Identification Sign

Valve identification sign must be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gage steel or 0.024-inch aluminum with red letters on a white background or white letters on red background. Wording of sign must include, but not be limited to "main drain", "auxiliary drain", "inspector's test", "alarm test", "alarm line", and similar wording as required to identify operational components. Where there is more than one sprinkler system, signage must include specific details as to the respective system.

PART 3 EXECUTION

3.1 VERIFYING ACTUAL FIELD CONDITIONS

Before commencing work, examine all adjoining work on which the contractor's work that is dependent for perfect workmanship according to the intent of this specification section, and report to the Contracting

Officer's Representative a condition that prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.

3.2 INSTALLATION

The installation must be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Locate sprinklers in a consistent pattern with ceiling grid, lights, and air supply diffusers. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

a. Piping offsets, fittings, and other accessories required must be furnished to provide a complete installation and to eliminate interference with other construction.

b. Wherever the contractor's work interconnects with work of other trades the Contractor must coordinate with other Contractors to insure all Contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access (dampers and similar equipment) that are concealed above hung ceilings by permanent color coded pins/tabs in the ceiling directly below the item.

c. Provide required supports and hangers for piping, conduit, and equipment so that loading will not exceed allowable loadings of structure. Submittal of a bid must be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.

3.2.1 Waste Removal

At the conclusion of each day's work, clean up and stockpile on site all waste, debris, and trash which may have accumulated during the day as a result of work by the contractor and of his presence on the job. Sidewalks and streets adjoining the property must be kept broom clean and free of waste, debris, trash and obstructions caused by work of the contractor, which will affect the condition and safety of streets, walks, utilities, and property.

3.3 ABOVEGROUND PIPING INSTALLATION

The methods of fabrication and installation of the aboveground piping must fully comply with the requirements and recommended practices of NFPA 13 and this specification section.

3.3.1 Protection of Piping Against Earthquake Damage

Seismic restraint is not required.

3.3.2 Piping in Exposed Areas

Install exposed piping without diminishing exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, must be installed to provide maximum headroom.

3.3.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping must be concealed above ceilings. Piping must be inspected, hydrostatically tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas must be concealed.

3.3.4 Pendent Sprinklers

a. Drop nipples to pendent sprinklers must consist of minimum 1-inch pipe with a reducing coupling into which the sprinkler must be threaded.

b. Where sprinklers are installed below suspended or dropped ceilings, drop nipples must be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling must not extend below the underside of the ceiling.

c. Recessed pendent sprinklers must be installed such that the distance from the sprinkler deflector to the underside of the ceiling must not exceed the manufacturer's listed range and must be of uniform depth throughout the finished area.

d. Pendent sprinklers in suspended ceilings must be located in the center of the tile (plus or minus 2 inches).

3.3.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers must contain no fittings between the branch line tee and the reducing coupling at the sprinkler.

3.3.6 Pipe Joints

Pipe joints must conform to NFPA 13, except as modified herein. Not more than four threads must show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints must be provided where indicated or required by NFPA 13. Grooved pipe and fittings must be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools must be products of the same manufacturer. For copper tubing, pipe and groove dimensions must comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field must be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe must be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances.

3.3.7 Reducers

Reductions in pipe sizes must be made with one-piece tapered reducing fittings. When standard fittings of the required size are not manufactured, single bushings of the face or hex type will be permitted. Where used, face bushings must be installed with the outer face flush with the face of the fitting opening being reduced. Bushings cannot be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2-inch.

3.3.8 Pipe Penetrations

a. Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors must be core-drilled and provided with pipe sleeves. Each sleeve must be Schedule 40 galvanized steel, ductile-iron or cast-iron pipe and extend through its respective wall or floor and be cut flush with each wall surface. Sleeves must provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe must be firmly packed with mineral wool insulation.

b. Where pipes and sleeves penetrate fire walls, fire partitions, or floors, pipes/sleeves must be firestopped in accordance with Section 07 84 00 FIRESTOPPING.

c. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe must be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

d. All penetrations through the boundary of rooms/areas identified as secure space area must meet ICS 705-1.

3.3.9 Escutcheons

Escutcheons must be provided for pipe penetration in finished areas of ceilings, floors and walls. Escutcheons must be securely fastened to the pipe at surfaces through which piping passes.

3.3.10 Inspector's Test Connection

Unless otherwise indicated, the test connection must consist of 1-inch pipe connected to the remote branch line; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test". All test connection piping must be inside of the building and penetrate the exterior wall at the location of the discharge orifice only. The discharge orifice must be located outside the building wall no more than 2 feet above finished grade, directed so as not to cause damage to adjacent construction or landscaping during full flow discharge, or to the sanitary sewer. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building. Do not discharge to the roof. Discharge to floor drains, janitor sinks or similar fixtures is not permitted.

Provide concrete splash blocks at all drain and inspector's test connection discharge locations if not discharging to a concrete surface. Splash blocks must be large enough to mitigate erosion and not become dislodged during a full flow of the drain. Ensure all discharged water drains away from the facility and does not cause property damage.

3.3.11 Drains

a. Main drain piping must be provided to discharge at a safe point outside the building, no more than 2 feet above finished grade. Provide a concrete splash block at drain outlet. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building.

b. Auxiliary drains must be provided as required by NFPA 13. Auxiliary drains are permitted to discharge to a floor drain if the drain is sized to accommodate full flow (min 40 gpm). Discharge to service sinks or similar plumbing fixtures is not permitted.

3.3.12 Identification Signs

Signs must be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Main drain test results must be etched into main drain identification sign. Hydraulic design data must be etched into the nameplates and permanently affixed to each sprinkler riser as specified in NFPA 13. Provide labeling on the surfaces of all feed and cross mains to show the pipe function (e.g., "Sprinkler System", "Fire Department Connection", "Standpipe") and normal valve position (e.g. "Normally Open", "Normally Closed"). For pipe sizes 4-inch and larger provide white painted stenciled letters and arrows, a minimum of 2 inches in height and visible from at least two sides when viewed from the floor. For pipe sizes less than 4-inch, provide white painted stenciled letters and arrows, a minimum of 0.75-inch in height and visible from the floor.

3.4 ELECTRICAL

Except as modified herein, electric equipment and wiring must be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Alarm signal wiring connected to the building fire alarm control system must be by the fire alarm installer.

3.5 PAINTING

Color code mark piping red.

3.6 FIELD QUALITY CONTROL

3.6.1 Test Procedures

Submit detailed test procedures, prepared and signed by the NICET Level III Fire Sprinkler Technician, and the representative of the installing company, and reviewed by the QFPE 30 days prior to performing system tests. Detailed test procedures must list all components of the installed system. Test procedures must include sequence of testing, time estimate for each test, and sample test data forms. The test data forms must be in a check-off format (pass/fail with space to add applicable test data; similar to the forms in NFPA 13). The test procedures and accompanying test data forms must be used for the pre-Government testing and the Government final testing.

a. Provide space to identify the date and time of each test. Provide space to identify the names and signatures of the individuals conducting and witnessing each test.

3.6.2 Pre-Government Testing

3.6.2.1 Verification of Compliant Installation

Conduct inspections and tests to ensure that equipment is functioning properly. Tests must meet the requirements of paragraph entitled "Minimum System Tests" and "System Acceptance" as noted in NFPA 13. The Contractor and QFPE must be in attendance at the pre-Government testing to make necessary adjustments. After inspection and testing is complete, provide a signed Verification of Compliant Installation letter by the QFPE that the installation is complete, compliant with the specification and fully operable. The letter must include the names and titles of the witnesses to the pre-Government tests. Provide all completion documentation as required by NFPA 13 and the test reports noted below.

a. NFPA 13 Aboveground Material and Test Certificate

b. NFPA 13 Underground Material and Test Certificate

3.6.2.2 Request for Government Final Test

When the verification of compliant installation has been completed, submit a formal request for Government final test to the Contracting Officers Designated Representative (COR). Government final testing will not be scheduled until the DFPE has received copies of the request for Government final testing and Verification of Compliant Installation letter with all required reports. Government final testing will not be performed until after the connections to the building fire alarm system have been completed and tested to confirm communications are fully functional. Submit request for test at least 15 calendar days prior to the requested test date.

3.6.3 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests must be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.6.4 Government Final Tests

The tests must be performed in accordance with the approved test procedures in the presence of the DFPE. Furnish instruments and personnel required for the tests. The following must be provided at the job site for Government Final Testing:

a. The manufacturer's technical representative.

b. The contractor's Qualified Fire Protection Engineer (QFPE).

c. Marked-up red line drawings of the system as actually installed.

Government Final Tests will be witnessed by the Contracting Officer and the Qualified Fire Protection Engineer (QFPE). At this time, all required tests noted in the paragraph "Minimum System Tests" must be repeated at their discretion.

3.7 MINIMUM SYSTEM TESTS

The system, including the underground water mains, and the aboveground piping and system components, must be tested to ensure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure must be tested in accordance with NFPA 13 and NFPA 24.

3.7.1 Underground Piping

3.7.1.1 Flushing

Underground piping must be flushed at a minimum of 10 fps in accordance with NFPA 24.

3.7.1.2 Hydrostatic Test

New underground piping must be hydrostatically tested in accordance with NFPA 24.

3.7.2 Aboveground Piping

3.7.2.1 Hydrostatic Test

Aboveground piping must be hydrostatically tested in accordance with NFPA 13. There must be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure must be read from a gauge located at the low elevation point of the system or portion being tested.

3.7.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly must be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor must provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5-inch diameter hoses, playpipe nozzles or flow diffusers, calibrated pressure gauges, and pitot tube gauge. The Contractor must provide all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction loss) across the assembly must be recorded. A metal placard must be provided on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate determined during the preliminary testing. The pressure drop must be compared to the manufacturer's data and the readings observed during the final inspections and tests.

3.7.3 Main Drain Flow Test

Following flushing of the underground piping, a main drain test must be made to verify the adequacy of the water supply. Static and residual pressures must be recorded on the certificate specified in paragraph SUBMITTALS.

3.8 SYSTEM ACCEPTANCE

Following acceptance of the system, as-built drawings and O&M manuals must be delivered to the Contracting Officer for review and acceptance. Submit six sets of detailed as-built drawings. The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings must be provided at the time of, or prior to the final acceptance test.

a. Provide one set of full size paper as-built drawings and schematics. The drawings must be prepared electronically and sized no less than the contract drawings. Furnish one set of CDs or DVDs containing software back-up and CAD based drawings in latest version of AutoCAD and portable document formats of as-built drawings and schematics.

b. Provide operating and maintenance (O&M) instructions.

3.9 ONSITE TRAINING

Conduct a training course for the responding fire department and operating and maintenance personnel as designated by the Contracting Officer. Training must be performed on two separate days (to accommodate different shifts of Fire Department personnel) for a period of 4 hours of normal working time and must start after the system is functionally complete and after the final acceptance test. The on-site training must cover all of the items contained in the approved Operating and Maintenance Instructions.

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SECTION 22 00 00

PLUMBING, GENERAL PURPOSE
11/15, CHG 4: 05/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2018) Hypochlorites

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M	(2021) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	(2023) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A515/A515M	(2017; R2022) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM B32	(2020) Standard Specification for Solder Metal

ASTM B813	(2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2665	(2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2822/D2822M	(2005; R 2011; E 2011) Standard Specification for Asphalt Roof Cement, Asbestos-Containing
ASTM D2855	(2015) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	(2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3311	(2017) Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM F409	(2022) Standard Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F891	(2016) Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core
ASTM F1760	(2016; R 2020) Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	(2021) International Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(2018) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(2018) Pipe Hangers and Supports -

	Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-72	(2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-78	(2011) Cast Iron Plug Valves, Flanged and Threaded Ends

NSF INTERNATIONAL (NSF)

NSF/ANSI 14	(2022) Plastics Piping System Components and Related Materials

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man	(2016) Firestopping: Plastic Pipe in Fire Resistive Construction

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508	(2023) Hose Clamp Specifications

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; G

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates

Materials

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

1.3 STANDARD PRODUCTS

Specified materials shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.2 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.3 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.3.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.3.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

1.6 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.8 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLE I. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used underground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

a. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

b. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

c. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

d. Solder Material: Solder metal shall conform to ASTM B32.

e. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.

f. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

g. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.

h. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A183.

i. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.

j. Flanged fittings including, but not limited to, flanges, bolts, nuts and bolt patterns shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Asphalt Roof Cement: ASTM D2822/D2822M.

b. Hose Clamps: SAE J1508.

c. Hypochlorites: AWWA B300.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Valves shall conform to the following standards:

Description	Standard
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78

2.4 DRAINS

2.4.1 Floor Drains

Floor drains shall consist of a nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection.

2.5 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F409 with slip joint inlet and swivel. Traps shall be without a cleanout.

2.6 MISCELLANEOUS PIPING ITEMS

2.6.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.6.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.6.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.6.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.6.3 Pipe Hangers (Supports)

Provide MSS SP-58 Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.6.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary traps and accessories. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment.

3.1.1.2 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Unions and Flanges

Flanges shall not be concealed in walls, ceilings, or partitions. Flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.3 Plastic Pipe

PVC pipe shall have joints made with solvent cement elastomeric, threading, or mated flanged.

3.1.3 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.3.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

a. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

b. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.

c. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

3.1.3.2 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs FLASHING REQUIREMENTS and WATERPROOFING, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.3.3 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.4 Supports

3.1.4.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.4.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-58 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 4 inches.

(2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-58 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less that 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.4.3 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.5 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. Cleanouts shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches.

3.2 FIXTURES AND FIXTURE TRIMMINGS

3.2.1 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on plastic pipe may be plastic conforming to ASTM D3311.

3.3 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.4 TESTS, FLUSHING AND DISINFECTION

3.4.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.

3.4.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.5 TABLES

TABLE I

PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS

It #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
1	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D2665, ASTM F891, (Sch 40) ASTM F1760	X	X	X	X	X	X	X

SERVICE:

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent
E - Interior Rainwater Conductors Aboveground
F - Corrosive Waste And Vent Above And Belowground
G - Condensate Drain Aboveground

* - Hard Temper

-- End of Section --

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC
11/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 203	(1990; R 2011) Field Performance Measurements of Fan Systems

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

ASHRAE 62.1	(2019) Ventilation for Acceptable Indoor Air Quality

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(2002; 6th ed) National Standards for Total System Balance
AABC MN-4	(1996) Test and Balance Procedures

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV	(2006) Procedural Standards for Measurements and Assessment of Sound and Vibration
NEBB PROCEDURAL STANDARDS	(2015) Procedural Standards for TAB (Testing, Adjusting and Balancing) Environmental Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1780	(2002) HVAC Systems - Testing, Adjusting and Balancing, 3rd Edition
SMACNA 1858	(2004) HVAC Sound And Vibration Manual - First Edition
SMACNA 1972 CD	(2012) HVAC Air Duct Leakage Test Manual - 2nd Edition

1.2 DEFINITIONS

a. AABC: Associated Air Balance Council

b. COTR: Contracting Officer's Technical Representative

c. DALT: Duct air leakage test

d. DALT'd: Duct air leakage tested

e. HVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling

f. NEBB: National Environmental Balancing Bureau

g. Out-of-tolerance data: Pertains only to field acceptance testing of Final DALT or TAB report. When applied to DALT work, this phase means "a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction and sealant class." When applied to TAB work this phase means "a measurement taken during TAB field acceptance testing which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter."

h. Season of maximum heating load: The time of year when the outdoor temperature at the project site remains within plus or minus 30 degrees Fahrenheit of the project site's winter outdoor design temperature, throughout the period of TAB data recording.

i. Season of maximum cooling load: The time of year when the outdoor temperature at the project site remains within plus or minus 5 degrees Fahrenheit of the project site's summer outdoor design temperature, throughout the period of TAB data recording.

j. Season 1, Season 2: Depending upon when the project HVAC is completed and ready for TAB, Season 1 is defined, thereby defining Season 2. Season 1 could be the season of maximum heating load, or the season of maximum cooling load.

k. Sound measurements terminology: Defined in AABC MN-1, NEBB MASV, or SMACNA 1858 (TABB).

l. TAB: Testing, adjusting, and balancing (of HVAC systems)

m. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed

n. TAB Agency: TAB Firm

o. TAB team field leader: TAB team field leader

p. TAB team supervisor: TAB team engineer

q. TAB team technicians: TAB team assistants

r. TABB: Testing Adjusting and Balancing Bureau

1.2.1 Similar Terms

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results.

The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS			
Contract Term	AABC Term	NEBB Term	TABB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems	International Standards for Environmental Systems Balance
TAB Specialist	TAB Engineer	TAB Supervisor	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures	Field Readiness Check & Prelim. Field Procedures

1.3 WORK DESCRIPTION

The work includes duct air leakage testing (DALT) and testing, adjusting, and balancing (TAB) of new heating, ventilating, and cooling (HVAC) air and water distribution systems including equipment and performance data, ducts, and piping which are located within, on, under, between, and adjacent to buildings, including records of existing conditions.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Firm's qualifications. Comply with requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) as supplemented and modified by this specification section. All recommendations and suggested practices contained in the TAB procedural standards are considered mandatory.

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct DALT testing in compliance with the requirements specified in SMACNA 1972 CD, except as supplemented and modified by this section. Conduct DALT and TAB work in accordance with the requirements of this section.

1.3.1 Air Distribution Systems

Test, adjust, and balance systems (TAB) in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.2 Water Distribution Systems

TAB systems in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to water distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL

SYSTEMS. At Contractor's option and with Contracting Officer's written approval, the piping systems may be insulated before systems are TAB'd.

Terminate piping insulation immediately adjacent to each flow control valve, automatic control valve, or device. Seal the ends of pipe insulation and the space between ends of pipe insulation and piping, with waterproof vapor barrier coating.

After completion of work under this section, insulate the flow control valves and devices as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.3 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings:

1. A unique number or mark for each piece of equipment or terminal.

2. Air quantities at air terminals.

3. Air quantities and temperatures in air handling unit schedules.

4. Water quantities and temperatures in thermal energy transfer equipment schedules.

5. Water quantities and heads in pump schedules.

6. Water flow measurement fittings and balancing fittings.

7. Ductwork Construction and Leakage Testing Table that defines the DALT test requirements, including each applicable HVAC duct system ID or mark, duct pressure class, duct seal class, and duct leakage test pressure. This table is included in the file for Graphics for Unified Facilities Guide Specifications: http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-gra

The Testing, Adjusting, and Balancing (TAB) Specialist must review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system, including records of existing conditions, and systems readiness check. The TAB Specialist must provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

Submit three copies of the TAB Schematic Drawings and Report Forms to the Contracting Officer, no later than 21 days prior to the start of TAB field measurements.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Records of Existing Conditions; G

TAB Firm; G

Designation of TAB Team Assistants; G

Designation of TAB Team Engineer; G or TAB Specialist; G

Designation of TAB Team Field Leader; G

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

SD-03 Product Data

Equipment and Performance Data; G

TAB Related HVAC Submittals; G

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB team engineer and assistant.

TAB Procedures; G

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration; G

Systems Readiness Check; G

TAB Execution; G

TAB Verification; G

SD-06 Test Reports

Completed Pre-Final DALT Report; G

Certified Final DALT Report; G

TAB Design Review Report; G

TAB Report; G

SD-07 Certificates

Independent TAB Agency and Personnel Qualifications; G

DALT and TAB Submittal and Work Schedule; G

TAB Pre-Field Engineering Report; G

TAB Firm; G

Design Review Report; G

Pre-field DALT Preliminary Notification; G

Advanced Notice for TAB Field Work; G

Prerequisite HVAC Work Check Out List; G

1.5 QUALITY ASSURANCE

1.5.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to Contracting Officer for approval:

a. Independent AABC or NEBB or TABB TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

1.5.2 TAB Standard

Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations.

All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures must be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are considered mandatory, including the latest requirements of ASHRAE 62.1.

1.5.3 Qualifications

1.5.3.1 TAB Firm

The TAB Firm must be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications.

Certification must be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor must immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm will be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor.

These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm must be a prime subcontractor of the Contractor and be financially and corporately independent of the mechanical subcontractor, reporting directly to and paid by the Contractor.

1.5.3.2 TAB Specialist

The TAB Specialist must be either a member of AABC,an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification must be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist will be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.5.3.3 TAB Specialist Responsibilities

TAB Specialist responsibilities include all TAB work specified herein and in related sections under his direct guidance. The TAB specialist is required to be onsite on a daily basis to direct TAB efforts. The TAB Specialist must participate in the commissioning process specified in Section 01 91 00.15 TOTAL BUILDING COMMISSIONING.

1.5.3.4 TAB Related HVAC Submittals

The TAB Specialist must prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. Accompany the submittals identified on this list with a letter of approval signed and dated by the TAB Specialist when submitted to the Government. Ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

1.5.4 Responsibilities

The Contractor is responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate TAB execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in the paragraph TAB SUBMITTAL AND WORK SCHEDULE.

1.5.4.1 Contractor

a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by a group meeting the requirements specified in the paragraph TAB PERSONNEL QUALIFICATION REQUIREMENTS.

b. Pre-DALT/TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor, mechanical contractor, electrical contractor, and automatic temperature controls contractor.

c. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB agency:

   (1) Contract drawings and specifications

   (2) Approved submittal data for equipment

   (3) Construction work schedule

   (4) Up-to-date revisions and change orders for the previously listed items

d. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in the paragraph TAB SUBMITTAL AND WORK SCHEDULE is met.

e. Coordination of supporting personnel:

   Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the DALT and the TAB field measurement work.

Provide equipment mechanics to operate HVAC equipment and ductwork mechanics to provide the field designated test ports to enable TAB field team to accomplish the DALT and the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the DALT and the TAB field work.

Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.

f. Deficiencies: Ensure that the TAB Agency supervisor submits all Design/Construction deficiency notifications directly to the Contracting officer within 3 days after the deficiency is encountered. Further, ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.

g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB team supervisor in the design review report.

h. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. Do not allow the TAB team to commence TAB field work until all of the following are completed.

(1) HVAC system installations are fully complete.

(2) HVAC prerequisite checkout work lists specified in the paragraph PRE-FIELD TAB ENGINEERING REPORT are completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved prerequisite HVAC work checklist.

(3) DALT field checks for all systems are completed.

(4) HVAC system filters are clean for both Season 1 and Season 2 TAB field work.

i. Advance notice: Furnish to the Contracting Officer with advance written notice for the commencement of the DALT field work and for the commencement of the TAB field work.

j. Insulation work: For required DALT work , ensure that insulation is not installed on ducts to be DALT'd until DALT work on the subject ducts is complete. Later, ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.

1.5.4.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of the paragraph INDEPENDENT TAB AGENCY PERSONNEL QUALIFICATIONS. The work to be performed by the TAB agency is limited to testing, adjusting, and balancing of HVAC air and water systems to satisfy the requirements of this specification section.

1.5.4.3 TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Pre-DALT/TAB meeting: Attend meeting with Contractor.

c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, the during the DALT or TAB field work.

e. Pre-field DALT preliminary notification: Monitor the completion of the duct installation of each system and provide the necessary written notification to the Contracting Officer.

f. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.

g. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report is submitted.

h. Technical assistance for DALT work.

(1) Technical assistance: Provide immediate technical assistance to TAB field team.

(2) DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being implemented and to confirm the accuracy of the Pre-final DALT Report data which has been reported. Also, perform sufficient evaluation to allow the TAB supervisor to issue certification of the final report. Conduct the site visit full-time for a minimum of one 8 hour workday duration.

i. Final DALT report: Certify the DALT report. This certification includes the following work:

(1) Review: Review the Pre-final DALT report data. From these field reports, prepare the Certified Final DALT report.

(2) TAB Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.

j. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.

(1) TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration. Review the TAB final report data and certify the TAB final report.

k. Certified TAB report: Certify the TAB report. This certification includes the following work:

(1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.

(2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.

l. Design/Construction deficiencies: Within 3 working days after the TAB Agency has encountered any design or construction deficiencies, the TAB Supervisor must submit written notification directly to the Contracting Officer, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency must issue notice and request direction in the notification submittal.

m. TAB Field Check: The TAB team supervisor must attend and supervise TAB field check.

1.5.4.4 TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, EXECUTION.

b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

1.5.5 Test Reports

1.5.5.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance the following requirements:

a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA 1972 CD. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Include node numbers in the completed report forms to identify each duct section. The TAB supervisor must review and certify the report.

b. The TAB supervisor must include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition,provide the ductwork air leak testing (DALT) reports with a copy(s) of the calibration curve for each of the DALT test orifices used for testing.

c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments must have been calibrated within one year of the date of use in the field. Instrument calibration must be traceable to the measuring standards of the National Institute of Standards and Technology.

d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.5.5.2 Certified TAB Reports

Submit: TAB Report in the following manner:

a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data must be typewritten. Handwritten report forms or report data are not acceptable.

b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded.

c. System Diagrams: Provide updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.

d. Static Pressure Profiles: Report static pressure profiles for air duct systems. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. Include the following in the static pressure report data, in addition to AABC/NEBB/TABB required data:

(1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

(2) Report static pressure drop across DX coils, electric resistance heating coils and heat reclaim devices installed in unit cabinetry or the system ductwork.

(3) Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and

two-position, installed in unit cabinetry.

e. Duct Traverses: Report duct traverses for main and branch main supply, return, exhaust, relief and outside air ducts. This includes all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency must evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pilot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings must provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

g. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

h. Performance Curves: The TAB Supervisor must include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor must include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturi's and flow orifices TAB'd on the job.

1.6 SEQUENCING AND SCHEDULING

1.6.1 DALT and TAB Submittal and Work Schedule

Submit this schedule,and TAB Schematic Drawings, adapted for this particular contract, to the Contracting Officer (CO) for review and approval. Include with the submittal the planned calendar dates for each submittal or work item. Resubmit an updated version for CO approval every 90 calendar days. Compliance with the following schedule is the Contractor's responsibility.

Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.

Pre-DALT/TAB Meeting: Within 30 calendar days after the date of approval of the TAB agency and personnel, meet with the COTR.

Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

Pre-Field DALT Preliminary Notification: On completion of the duct installation for each system, notify the Contracting Officer in writing within 5 days after completion.

Ductwork Selected for DALT: Within 7 calendar days of Pre-Field DALT

Preliminary Notification, the COTR will select which of the project ductwork must be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected.

Submit Pre-final DALT Report: Within one working day after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

DALT Work Field Check: Upon approval of the Pre-final DALT Report, schedule the COTR's DALT field check work with the Contracting Officer.

Submit Final DALT Report: Within 15 calendar days after completion of successful DALT Work Field Check, submit TAB report.

Pre-Field TAB Engineering Report: Within 15 calendar days after approval of the TAB agency Personnel Qualifications, submit the Pre-Field TAB Engineering Report.

Prerequisite HVAC Work Check Out List and Advanced Notice For TAB Field Work: At a minimum of 115 calendar days prior to CCD, submit prerequisite HVAC work check out list certified as complete, and submit advance notice of commencement of TAB field work.

TAB Field Work: At a minimum of 90 calendar days prior to CCD, accomplish TAB field work.

Submit TAB Report: Within 15 calendar days after completion of TAB field work, submit TAB report.

TAB Field Check: 30 calendar days after Season 1 TAB report is approved by the Contracting Officer, conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work.

TAB Field Work: At a minimum of 90 calendar days prior to CCD, accomplish TAB field work; submit TAB report; and conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work .

1.6.1.1 TAB Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

1.6.1.2 Pre-Field DALT Preliminary Notification

Notification: On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing within 7 calendar days after completion.

1.6.1.3 TAB Pre-Field Engineering Report

Submit report containing the following information:

a. Step-by-step TAB procedure:

(1) Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.

(2) Air System Diagrams: Use the contract drawings and duct fabrication drawings if available to provide air system diagrams in the report showing the location of all terminal outlet supply, return, exhaust and transfer registers, grilles and diffusers. Use a key numbering system on the diagrams which identifies each outlet contained in the outlet airflow report sheets. Show intended locations of all traverses and static pressure readings.

(3) Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.

b. Pre-field data: Submit AABC or NEBB or SMACNA 1780 data report forms with the following pre-field information filled in:

(1) Design data obtained from system drawings, specifications, and approved submittals.

(2) Notations detailing additional data to be obtained from the contract site by the TAB field team.

(3) Designate the actual data to be measured in the TAB field work.

(4) Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which instruments the choice will be made. Place the instrument key number in the blank space where the measured data would be entered.

c. Prerequisite HVAC work checkout list: Provide a list of inspections and work items which are to be completed by the Contractor. This list must be acted upon and completed by the Contractor and then submitted and approved by the Contracting Officer prior to the TAB team coming to the contract site.

At a minimum, a list of the applicable inspections and work items listed in the NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" must be provided for each separate system to be TAB'd.

1.7 WARRANTY

Furnish workmanship and performance warranty for the DALT and TAB system work performed for a period not less than 1 years from the date of Government acceptance of the work; issued directly to the Government. Include provisions that if within the warranty period the system shows evidence of major performance deterioration, or is significantly out of tolerance, resulting from defective TAB or DALT workmanship, the corrective repair or replacement of the defective materials and correction of the defective workmanship is the responsibility of the TAB firm. Perform corrective action that becomes necessary because of defective materials and workmanship while system TAB and DALT is under warranty 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the TAB firm. The Contractor must also provide a 1 year contractor installation warranty.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 WORK DESCRIPTIONS OF PARTICIPANTS

Comply with requirements of this section.

3.2 PRE-DALT/TAB MEETING

Meet with the Contracting Officer's technical representative (COTR) to develop a mutual understanding relative to the details of the DALT work and TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

3.3 DALT PROCEDURES

3.3.1 Instruments, Consumables and Personnel

Provide instruments, consumables and personnel required to accomplish the DALT field work. Follow the same basic procedure specified below for TAB Field Work, including maintenance and calibration of instruments, accuracy of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

3.3.2 Advance Notice of Pre-Final DALT Field Work

On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing prior to the COTR's duct selection field visit.

3.3.3 Ductwork To Be DALT'd

From each duct system indicated as subject to DALT, the COTR will randomly select sections of each completed duct system for testing by the Contractor's TAB Firm. The sections selected will not exceed 20 percent of the total measured linear footage of duct systems indicated as subject to DALT. Sections of duct systems subject to DALT will include 20 percent of main ducts, branch main ducts, branch ducts and plenums for supply, return, exhaust, and plenum ductwork.

It is acceptable for an entire duct system to be DALT'd instead of disassembling that system in order to DALT only the 20 percent portion specified above.

3.3.4 DALT Testing

Perform DALT on the HVAC duct sections of each system as selected by the COTR. Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA 1972 CD.

3.3.5 Completed Pre-Final DALT Report

After completion of the DALT work, prepare a Pre-final DALT Report using the reporting forms specified. TAB team to furnish data required by those data report forms. Prepare the report neatly and legibly; the Pre-final DALT report is the basis for the Final DALT Report. TAB supervisor must review and certify the Pre-final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COTR that the field check of the Pre-final DALT Report data can commence.

3.3.6 Quality Assurance - COTR DALT Field Acceptance Testing

In the presence of the COTR and TAB team field leader, verify for accuracy Pre-final DALT Report data selected by the COTR. For each duct system, this acceptance testing shall be conducted on a maximum of 50 percent of the duct sections DALT'd.

Further, if any data on the Pre-final DALT report form for a given duct section is out-of-tolerance, then field acceptance testing shall be conducted on data for one additional duct section, preferably in the same duct system, in the presence of the COTR.

3.3.7 Additional COTR Field Acceptance Testing

If any of the duct sections checked for a given system are determined to have a leakage rate measured that exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction class and sealant class, terminate data checking for that section. The associated Pre-final DALT Report data for the given duct system will be disapproved. Make the necessary corrections and prepare a revised Pre-final DALT Report. Reschedule a field check of the revised report data with the COTR.

3.3.8 Certified Final DALT Report

On successful completion of all field checks of the Pre-final DALT Report data for all systems, the TAB Supervisor is to assemble, review, certify and submit the Final DALT Report to the Contracting Officer for approval.

3.3.9 Prerequisite for TAB Field Work

Do not commence TAB field work prior to the completion and approval, for all systems, of the Final DALT Report.

3.4 TAB PROCEDURES

3.4.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents.

That is, comply with the the requirements of AABC MN-1 or SMACNA 1780 (TABB) and SMACNA 1858 (TABB),except as supplemented and modified by this section.

Provide instruments and consumables required to accomplish the TAB work. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES and NEBB MASV, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section.

3.4.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.4.3 TAB Air Distribution Systems

3.4.3.1 Units With Coils

Report heating and cooling performance capacity tests for DX coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units and central built-up units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

   Do not determine entering and leaving wet and dry bulb temperatures by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

   Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.3.2 Air Handling Units

Air handling unit systems including fans (air handling unit fans, exhaust fans and winter ventilation fans), coils, ducts, plenums, mixing boxes, terminal units, variable air volume boxes, and air distribution devices for supply air, return air, outside air, mixed air relief air, and makeup air.

3.4.3.3 Makeup Air Units

Makeup air unit systems including fans, coils, ducts, plenums, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.4.3.4 Exhaust Fans

Exhaust fan systems including fans, ducts, plenums, grilles, and hoods for exhaust air.

3.4.4 TAB Work on Performance Tests Without Seasonal Limitations

3.4.4.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the heating systems and cooling systems.

3.4.4.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.4.4.3 Coils

Report heating and cooling performance capacity tests for DX for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For Central station air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units and central built-up units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing".

   Entering and leaving wet and dry bulb temperatures are not determined by single point measurement, but the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

   Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.5 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, contact the Contracting Officer for direction.

3.4.6 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph WORKMANSHIP, provide written notice as soon as possible to the Contractor and the Contracting Officer describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.4.7 TAB Reports

After completion of the TAB work, prepare a pre-final TAB report using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph WORKMANSHIP of this section.

Prepare the report neatly and legibly; the pre-final TAB report is the final TAB report minus the TAB supervisor's review and certification. Obtain, at the contract site, the TAB supervisor's review and certification of the TAB report.

Verbally notify the COTR that the field check of the TAB report data can commence; give this verbal notice 48 hours in advance of field check commencement. Do not schedule field check of the TAB report until the specified workmanship requirements have been met or written approval of the deviations from the requirements have been received from the

Contracting Officer.

3.4.8 Quality Assurance - COTR TAB Field Acceptance Testing

3.4.8.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COTR, random selections of data (water, air quantities, air motion) recorded in the TAB Report. Points and areas for field acceptance testing are to be selected by the COTR. Measurement and test procedures are the same as approved for TAB work for the TAB Report.

Field acceptance testing includes verification of TAB Report data recorded for the following equipment groups:

Group 1: All air handling units (central stations).

Group 2: 25 percent of the associated diffusers and registers.

Group 3: 25 percent of the supply diffusers, registers, grilles associated with constant volume air handling units.

Group 4: 25 percent of the return grilles, return registers, exhaust grilles and exhaust registers.

Group 5: 25 percent of the supply fans, exhaust fans, and pumps.

Further, if any data on the TAB Report for Groups 2 through 5 is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, additional group data verification is required in the presence of the COTR. Verify TAB Report data for one additional piece of equipment in that group. Continue this additional group data verification until out-of-tolerance data ceases to be found.

3.4.8.2 Additional COTR TAB Field Acceptance Testing

If any of the acceptance testing measurements for a given equipment group is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, terminate data verification for all affected data for that group. The affected data for the given group will be disapproved. Make the necessary corrections and prepare a revised TAB Report. Reschedule acceptance testing of the revised report data with the COTR.

Further, if any data on the TAB Report for a given field acceptance test group is out-of-tolerance, then field test data for one additional field test group as specified herein. Continue this increase field test work until out-of-tolerance data ceases to to be found. This additional field testing is up and above the original 25 percent of the of reported data entries to be field tested.

If there are no more similar field test groups from which to choose, additional field testing from another, but different, type of field testing group must be tested.

3.4.8.3 Prerequisite for Approval

Compliance with the field acceptance testing requirements of this section is a prerequisite for the final Contracting Officer approval of the TAB Report submitted.

3.5 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.

3.6 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

-- End of Section --

SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS
02/13, CHG 7: 05/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

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

ASHRAE 90.1 - IP	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A240/A240M	(2020a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A580/A580M	(2018) Standard Specification for Stainless Steel Wire
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C450	(2008) Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
ASTM C533	(2017) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534/C534M	(2020a) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C547	(2022) Standard Specification for Mineral Fiber Pipe Insulation

ASTM C552	(2022) Standard Specification for Cellular Glass Thermal Insulation
ASTM C585	(2010) Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
ASTM C591	(2021) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C592	(2022a) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C612	(2014; R 2019) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C795	(2008; R 2018) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C916	(2020) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C921	(2010; R 2015) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C1136	(2021) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C1710	(2011) Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form
ASTM D5590	(2000; R 2010; E 2012) Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2022) Standard Test Methods for Gravimetric Determination ofWater Vapor Transmission Rate of Materials
ASTM E2231	(2021) Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface

	Burning Characteristics

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	(8th Ed) National Commercial & Industrial Insulation Standards

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-3316	(1987; Rev C; Am 2 1990) Adhesives, Fire-Resistant, Thermal Insulation
MIL-A-24179	(1969; Rev A; Am 2 1980; Notice 1 1987; Notice 2 2020) Adhesive, Flexible Unicellular-Plastic Thermal Insulation

UNDERWRITERS LABORATORIES (UL)

UL 94	(2013; Reprint Apr 2022) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 723	(2018) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 2818	(2013) GREENGUARD Certification Program

For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SYSTEM DESCRIPTION

1.2.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-02 Shop Drawings

MICA Plates; G

Pipe Insulation Systems and Associated Accessories

Duct Insulation Systems and Associated Accessories

Equipment Insulation Systems and Associated Accessories

SD-03 Product Data

Pipe Insulation Systems; G

Duct Insulation Systems; G

Equipment Insulation Systems; G

SD-04 Samples

Thermal Insulation; G

Display Samples; G

SD-07 Certificates

Indoor air quality for adhesives; S

SD-08 Manufacturer's Instructions

Pipe Insulation Systems; G

Duct Insulation Systems; G

Equipment Insulation Systems; G

1.4 CERTIFICATIONS

1.4.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualification

Qualified installers will have successfully completed three or more similar type jobs within the last 5 years.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the manufacturer's unopened containers. Protect materials delivered and placed in storage from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Attach manufacturer's stamp or label giving the name of the manufacturer and brand, and a description of the material, date codes, and approximate shelf life (if applicable) to packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval. Insulation packages and containers must be asbestos free.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit a complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. Include the product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation. The product data must be copyrighted, have an identifying or publication number, and have been published prior to the issuance date of this solicitation. Submit materials furnished under this section together in a booklet and in conjunction with the MICA plates booklet (SD-02). Annotate the product data to indicate which MICA plate is applicable.

2.1.1 Insulation System

Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems that are located within, on, under, and adjacent to buildings; and for plumbing systems. Provide CFC and HCFC free insulation.

2.1.2 Surface Burning Characteristics

Unless otherwise specified, insulation must have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Determine flame spread, and smoke developed indexes, by ASTM E84 or UL 723. Test insulation in the same density and installed thickness as the material to be used in the actual construction. Prepare and mount test specimens according to ASTM E2231.

2.2 MATERIALS

Provide insulation that meets or exceed the requirements of ASHRAE 90.1 - IP. Ensure insulation exterior is cleanable, grease resistant, non-flaking and non-peeling. Provide compatible materials that do not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Use materials on stainless steel surfaces meeting ASTM C795 requirements. Do not use calcium silicate on chilled or cold water systems. Use asbestos free materials. Provide product recognized under UL 94 (if containing plastic) and listed in FM APP GUIDE.

2.2.1 Adhesives

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants must meet limit requirements of "Other" category within SCAQMD Rule 1168 sealants table). Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.2.1.1 Acoustical Lining Insulation Adhesive

Provide a nonflammable, fire-resistant adhesive conforming to ASTM C916, Type I.

2.2.1.2 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. To resist mold/mildew, use lagging adhesive meeting ASTM D5590 with 0 growth rating. Provide nonflammable and fire-resistant lagging adhesives that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Ensure adhesive is MIL-A-3316, Class 1, pigmented white and suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Apply lagging adhesives in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.1.3 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Ensure adhesive does not adversely affect, initially or in service, the insulation to which it is applied, nor cause any corrosive effect on metal to which it is applied. Ensure that any solvent dispersing medium or volatile component of the adhesive has no objectionable odor and does not contain any benzene or carbon tetrachloride. Ensure dried adhesive does not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive must be nonflammable and fire resistant. Flexible Elastomeric Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide product listed in FM APP GUIDE.

2.2.2 Caulking

ASTM C920, Type S, Grade NS, Class 25, Use A.

2.2.3 Corner Angles

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum must be ASTM B209, Alloy 3003, 3105, or 5005.

2.2.4 Fittings

Fabricated Fittings are the prefabricated fittings for flexible elastomeric pipe insulation systems in accordance with ASTM C1710. Together with the flexible elastomeric tubes, they provide complete system integrity for retarding heat gain and controlling condensation drip from chilled-water and refrigeration systems. Flexible elastomeric, fabricated fittings provide thermal protection (0.25 k) and condensation resistance (0.05 Water Vapor Transmission factor). For satisfactory performance, use properly installed protective vapor retarder/barriers and vapor stops on high relative humidity and below ambient temperature applications to reduce movement of moisture through or around the insulation to the colder interior surface.

2.2.5 Finishing Cement

ASTM C450: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C795.

2.2.6 Fibrous Glass Cloth and Glass Tape

Provide fibrous glass cloth, with 20X20 maximum mesh size, and glass tape with maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Provide tape consisting of 4 inch wide rolls. Provide Class 3 tape that is 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive.

2.2.7 Staples

Outward clinching type monel .

2.2.8 Jackets

2.2.8.1 Aluminum Jackets

Provide aluminum jackets consisting of corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Do not use corrugated aluminum jacket outdoors. Aluminum jacket securing bands must be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands must be 2 by 0.016 inch aluminum matching jacket material. Ensure bands for insulation below ground are 3/4 by 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, use bands at the circumferential joints that are designed by the manufacturer to seal the joints and hold the jacket in place.

2.2.8.2 Vapor Barrier/Vapor Retarder

Apply the following criteria to determine which system is required.

a. On ducts, equip piping and equipment operating below 85 degrees F or located outside with a vapor barrier.

2.2.9 Vapor Retarder Not Required

ASTM C921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Provide jacket with a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.2.10 Wire

Soft annealed ASTM A580/A580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2.11 Insulation Bands

Provide 1/2 inch wide; 26 gauge stainless steel insulation bands.

2.2.12 Sealants

Choose sealants from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Provide sealants with a maximum permeance of 0.02 perms based on Procedure B for ASTM E96/E96M, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.3 PIPE INSULATION SYSTEMS

Conform insulation materials to Table 1 and minimum insulation thickness as listed in Table 2 and meet or exceed the requirements of ASHRAE 90.1 - IP. Limit pipe insulation materials to those listed herein and meeting the following requirements:

2.3.1 Aboveground Cold Pipeline (-30 to 60 deg. F)

Provide insulation for outdoor, indoor, exposed or concealed applications, as follows:

2.3.1.1 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II. Type I, Grade 1 for tubular materials. Type II, Grade 1, for sheet materials. Ensure Type I and II have vapor retarder/vapor barrier skin on one or both sides of the insulation, and require an additional exterior vapor retarder covering for high relative humidity and below ambient temperature applications.

2.3.2 Aboveground Hot Pipeline (Above 60 deg. F)

Provide insulation for outdoor, indoor, exposed or concealed applications meeting the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.2.1 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II to 220 degrees F service. Type I for tubular materials. Type II for sheet materials.

2.3.2.2 Polyisocyanurate Insulation

ASTM C591, Type I. Supply the insulation with a factory applied vapor retarder/barrier that complies with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation and all covering must pass the flame spread index of 25 and the smoke developed index of 50 when tested in accordance with ASTM E84.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Factory Applied Insulation

Provide factory-applied ASTM C534/C534M Grade 1, Type II, flexible elastomeric closed cell insulation according to manufacturer's recommendations for insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier.

2.4.1.1 Rigid Insulation

Calculate the minimum thickness in accordance with ASHRAE 90.1 - IP.

2.4.1.2 Blanket Insulation

Calculate minimum thickness in accordance with ASHRAE 90.1 - IP.

2.4.2 Duct Insulation Jackets

2.4.2.1 Metal Jackets

2.4.2.1.1 Aluminum Jackets

ASTM B209, Temper H14, minimum thickness of 27 gauge (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside dimension 8 inches and larger. Provide corrugated surface jackets for jacket outside dimension 8 inches and larger. Provide stainless steel bands, minimum width of 1/2 inch.

2.5 EQUIPMENT INSULATION SYSTEMS

Insulate equipment and accessories as specified in Tables 5 and 6. In outside locations, provide insulation 1/2 inch thicker than specified. Increase the specified insulation thickness for equipment where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface. Submit a booklet containing manufacturer's published installation instructions for the insulation systems in coordination with the submitted MICA Insulation Stds plates booklet. Annotate their installation instructions to indicate which product data and which MICA plate are applicable. The instructions must be copyrighted, have an identifying or publication number, and have been published prior to the issuance date of this solicitation. A booklet is also required by paragraphs titled: Pipe Insulation Systems and Duct Insulation Systems.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Apply insulation to unheated and uncooled piping and equipment. Do not compress flexible elastomeric cellular insulation at joists, studs, columns, ducts, and hangers. The insulation must not pull apart after a one hour period; replace any insulation found to pull apart after one hour.

3.1.1 Display Samples

Submit and display, after approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Identify each material used by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Contracting Officer will inspect display sample sections at the jobsite. Keep approved display sample sections on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

3.1.1.1 Pipe Insulation Display Sections

Include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

3.1.1.2 Duct Insulation Display Sections

Display sample sections for rigid and flexible duct insulation used on the job. Use a temporary covering to enclose and protect display sections for duct insulation exposed to weather

3.1.2 Installation

Except as otherwise specified, install material in accordance with the manufacturer's written instructions. Do not apply insulation materials until tests and heat tracing specified in other sections of this specification are completed. Remove material such as rust, scale, dirt and moisture from surfaces to receive insulation. Keep insulaton clean and dry. Do not remove insulation from its shipping containers until the day it is ready to use and return to like containers or equally protect from dirt and moisture at the end of each workday. Thoroughly clean insulation that becomes dirty prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, reject the insulation, and immediately remove from the jobsite. Stagger joints on multi layer insulation. Mix mineral fiber thermal insulating cement with demineralized water when used on stainless steel surfaces. Install insulation, jacketing and accessories in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.3 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, seal the penetration with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING.

3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Install flexible elastomeric cellular insulation with seams and joints sealed with rubberized contact adhesive. Do not use flexible elastomeric cellular insulation on surfaces greater than 220 degrees F. Stagger seams when applying multiple layers of insulation. Protect insulation exposed to weather and not shown to have vapor barrier weatherproof jacketing with two coats of UV resistant finish or PVC or metal jacketing as recommended by the manufacturer after the adhesive is dry and cured.

3.1.4.1 Adhesive Application

Apply a brush coating of adhesive to both butt ends to be joined and to both slit surfaces to be sealed. Allow the adhesive to set until dry to touch but tacky under slight pressure before joining the surfaces. Ensure insulation seals at seams and joints are not capable of being pulled apart one hour after application. Replace insulation that can be pulled apart one hour after installation.

3.1.4.2 Adhesive Safety Precautions

Use natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

3.1.5 Welding

Welding is not permitted on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.6 Pipes/Ducts/Equipment That Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items as specified.

3.2 PIPE INSULATION SYSTEMS INSTALLATION

Install pipe insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.2.1 Pipe Insulation

3.2.1.1 General

Install pipe insulation on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Install full length units of insulation using a single cut piece to complete a run. Do not use cut pieces or scraps abutting each other. Omit pipe insulation on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, for fixtures used by the physically handicapped, insulate the hot water supply and drain, including the trap, where exposed.

c. Sanitary drain lines.

d. Air chambers.

e. Adjacent insulation.

f. ASME stamps.

g. Access plates of fan housings.

h. Cleanouts or handholes.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

Provide continuous pipe insulation through the sleeve.

Provide an aluminum jacket or vapor barrier/weatherproofing self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed with factory applied moisture retarder over the insulation wherever penetrations require sealing.

3.2.1.2.1 Penetrate Interior Walls

Provide aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 plies standard grade, silver, white, black and embossed which extends 2 inches beyond either side of the wall and secure on each end with a band.

3.2.1.2.2 Penetrating Floors

Extend the aluminum jacket from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

3.2.1.2.3 Penetrating Waterproofed Floors

Extend the aluminum jacket rom below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

3.2.1.2.4 Penetrating Exterior Walls

Continue the aluminum jacket required for pipe exposed to weather through the sleeve to a point 2 inches beyond the interior surface of the wall.

3.2.1.2.5 Penetrating Roofs

Insulate pipe as required for interior service to a point flush with the top of the flashing and sealed with flashing sealant. Tightly butt the insulation for exterior application to the top of flashing and interior insulation. Extend the exterior aluminum jacket 2 inches down beyond the end of the insulation to form a counter flashing. Seal the flashing and counter flashing underneath with metal jacketing/flashing sealant.

3.2.1.3 Pipes Passing Through Hangers

Ensure insulation, whether hot or cold application, is continuous through hangers. Support all horizontal pipes 2 inches and smaller on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-58. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, install insulation inserts as specified below for piping larger than 2 inches, or factory insulated hangers (designed with a load bearing core) can be used.

3.2.1.3.1 Horizontal Pipes Larger Than 2 Inches at 60 Degrees F and Above

Supported on hangers in accordance with MSS SP-58, and Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2.1.3.2 Horizontal Pipes Larger Than 2 Inches and Below 60 Degrees F

Supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-58. Install an insulation insert of cellular glass, prefabricated insulation pipe hangers, or perlite above 80 degrees F above each shield. Ensure insert covers no less than the bottom 180-degree arc of the pipe. Provide inserts that are the same thickness as the insulation, and extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. Ensure the insulation jacket is continuous over the wooden dowel, wooden block, or insulation insert.

3.2.1.3.3 Vertical Pipes

Supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-58 covering the 360-degree arc of the insulation. Install an insulation insert of cellular glass or calcium silicate between each shield and the pipe. Ensure the insert covers the 360-degree arc of the pipe. Provide inserts that are the same thickness as the insulation, and extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. Ensure the insulation jacket is continuous over the wooden dowel, wooden block, or insulation insert. Support the vertical weight of the pipe with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, support the weight of the pipe additionally with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. Use insulated hangers and seal the insulation jacket as indicated herein for anchors in a similar service.

3.2.1.3.4 Inserts

Covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, overlap the adjoining pipe jacket 1-1/2 inches, and seal as required for the pipe jacket. Use jacket material to cover inserts in flexible elastomeric cellular insulation conforming to ASTM C1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Use tubular form flexible elastomeric cellular pipe insulation for pipe sizes 6 inches and less. Grade 1, Do not stretch Type II sheet insulation used on pipes larger than 6 inches around the pipe. On pipes larger than 12 inches, adhere the insulation directly to the pipe on the lower 1/3 of the pipe. Stagger seams when applying multiple layers of insulation. Insulate sweat fittings with miter-cut pieces the same size as on adjacent piping. Insulate screwed fittings with sleeved fitting covers fabricated from miter-cut pieces and overlap and seal to the adjacent pipe insulation. Type II requires an additional exterior vapor retarder/barrier covering for high relative humidity and below ambient temperature applications.

3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, utilize aluminum or flexible laminate cladding (comprised of elastomeric, plastic or metal foil laminate) laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket, - less than 0.0000 permeability; (greater than 3 ply, standard grade, silver, white, black and embossed) aluminum jackets. Protect pipe insulation to the 6 foot level.

3.2.1.6 Pipe Insulation Material and Thickness

Pipe insulation materials must be as listed in Table 1 and must meet or exceed the requirements ofASHRAE 90.1 - IP.

TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd
Refrigerant Suction Piping (35 degrees F nominal)					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Condensate Drain Located Inside Building					
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Note: VR/VB = Vapor Retarder/Vapor Barrier					

TABLE 2						
Piping Insulation Thickness (inch) Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.						
Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
Refrigerant Suction Piping (35 degrees F nominal)						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Condensate Drain Located Inside Building						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A

3.2.2 Aboveground Cold Pipelines

Insulate the following cold pipelines for minus 30 to plus 60 degrees F in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

a. Make-up water.

b. Refrigerant suction lines.

c. Air conditioner condensate drains.

3.2.2.1 Insulation Material and Thickness

Determine insulation thickness for cold pipelines using Table 2.

3.2.2.2 Factory or Field applied Jacket

Cover insulation with a factory applied vapor retarder jacket/vapor barrier or field applied seal welded PVC jacket or greater than 3 ply laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, standard grade, sliver, white, black and embossed for use with Mineral Fiber, Cellular Glass, and Phenolic Foam Insulated Pipe. For insulation inside the building, to be protected with an aluminum jacket or greater than 3 ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, Embossed Silver, White & Black, install the insulation and vapor retarder jacket as specified herein. Install the aluminum jacket or greater than 3 ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, White & Black, as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, provide aluminum jackets or greater than 3 ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, white & black, for pipe insulation to the 6 ft level.

3.2.2.3 Installing Insulation for Straight Runs Hot and Cold Pipe

Apply insulation to the pipe with tight butt joints. Seal all butted joints and ends with joint sealant and seal with a vapor retarder coating, greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or PVDC adhesive tape.

3.2.2.3.1 Longitudinal Laps of the Jacket Material

Overlap not less than 1-1/2 inches. Provide butt strips 3 inches wide for circumferential joints.

3.2.2.3.2 Laps and Butt Strips

Secure with adhesive and staple on 4 inch centers if not factory self-sealing. If staples are used, seal in accordance with paragraph STAPLES below. Note that staples are not required with cellular glass systems.

3.2.2.3.3 Factory Self-Sealing Lap Systems

May be used when the ambient temperature is between 40 and 120 degrees F during installation. Install the lap system in accordance with manufacturer's recommendations. Use a stapler only if specifically recommended by the manufacturer. Where gaps occur, replace the section or repair the gap by applying adhesive under the lap and then stapling.

3.2.2.3.4 Staples

Coat all staples, including those used to repair factory self-seal lap systems, with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - 0.0000 perm adhesive tape. Coat all seams, except those on factory self-seal systems, with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.5 Breaks and Punctures in the Jacket Material

Patch by wrapping a strip of jacket material around the pipe and secure it with adhesive, staple, and coat with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. Extend the patch not less than 1-1/2 inches past the break.

3.2.2.3.6 Penetrations Such as Thermometers

Fill the voids in the insulation and seal with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.7 Flexible Elastomeric Cellular Pipe Insulation

Install by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. Secure all seams and butt joints and seal with adhesive. When using self seal products, secure only the butt joints with adhesive. Push insulation on the pipe, never pulled. Stretching of insulation may result in open seams and joints. Clean cut all edges. Rough or jagged edges of the insulation are not be permitted. Use proper tools such as sharp knives. Do not stretch Grade 1, Type II sheet insulation around the pipe when used on pipe larger than 6 inches. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.2.4 Insulation for Fittings and Accessories

a. Butt pipe insulation tightly to the insulation of the fittings and accessories. Seal the butted joints and ends with joint sealant and seal with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

b. Place precut or preformed insulation around all fittings and accessories and conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation must be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Use insulation of the same thickness and conductivity as the adjoining pipe insulation. If nesting size insulation is used, overlap the insulation 2 inches or one pipe diameter. Elbows insulated using segments must conform to MICA Tables 12.20 "Mitered Insulation Elbow'. Submit a booklet containing completed MICA Insulation Stds plates detailing each insulating system for each pipe, duct, or equipment insulating system, after approval of materials and prior to applying insulation.

(1) Ensure MICA plates detail the materials to be installed and the specific insulation application. Submit all MICA plates required showing the entire insulating system, including plates required to

show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. Present all variations of insulation systems including locations, materials, vaporproofing, jackets and insulation accessories.

(2) If the Contractor elects to submit detailed drawings instead of edited MICA Plates, ensure the detail drawings are technically equivalent to the edited MICA Plate submittal.

c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers must be protected with PVDC or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Overlap tap seams 1 inch. Extend the coating out onto the adjoining pipe insulation 2 inches. Protect fabricated insulation with a factory vapor retarder jacket with either greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape, standard grade, silver, white, black and embossed or PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, seal the joints with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

d. Insulate anchors attached directly to the pipe for a sufficient distance to prevent condensation but no less than 6 inches from the insulation surface.

e. Mark insulation to show the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Use factory precut or premolded insulation segments under the fitting covers for elbows. Use insulation segmentswhich are the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. Secure the covers by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seal seams in the cover, and tacks and laps to adjoining pipe insulation jacket, with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Aboveground Hot Pipelines

3.2.3.1 General Requirements

Insulate all hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, in accordance with Table 2. This includes but is not limited to the following:

a. Domestic hot water supply & re-circulating system.

b. Steam.

c. Condensate & compressed air discharge.

d. Hot water heating.

e. Heated oil.

f. Water defrost lines in refrigerated rooms.

Cover insulation, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

3.2.3.2 Insulation for Fittings and Accessories

Butt pipe insulation tightly to the insulation of the fittings and accessories. Seal butted joints and ends with joint sealant. Mark insulation to show the location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation.

3.2.3.2.1 Precut or Preformed

Place precut or preformed insulation around all fittings and accessories. Use the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

3.2.3.2.2 Rigid Preformed

Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Use insulation that is the same thickness and conductivity as the adjoining pipe insulation. If nesting size insulation is used, do not overlap insulation 2 inches or one pipe diameter. Elbows insulated using segments must conform to MICA Tables 12.20 "Mitered Insulation Elbow".

3.2.4 Piping Exposed to Weather

Insulate and jacket piping exposed to weather as specified for the applicable service inside the building. After this procedure, apply a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket, stainless steel or PVC jacket.

PVC jacketing requires no factory-applied jacket beneath it, however apply an all service jacket if factory applied jacketing is not furnished. Treat flexible elastomeric cellular insulation exposed to weather in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION in PART 3.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. Overlap the jacket no less than 2 inches at longitudinal and circumferential joints and secure with bands at no more than 12 inch centers. Overlap longitudinal joints down to shed water and locate at 4 or 8 o'clock positions. Seal joints on piping 60 degrees F and below with metal jacketing/flashing sealant while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, caulk joints to prevent moisture penetration. Seal joints on piping above 60 degrees F with a moisture retarder.

3.2.4.2 Insulation for Fittings

Insulate and finish flanges, unions, valves, fittings, and accessories as specified for the applicable service. Apply two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer with glass tape embedded between coats. Overlap tap no less than 1 inch and the adjoining aluminum jacket no less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Provide molded PVC fitting covers when PVC jackets are used for straight runs of pipe. Provide PVC fitting covers that have adhesive welded joints and are weatherproof laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed, and UV resistant.

3.2.4.3 PVC Jacket

Provide ultraviolet resistant PVC jacket that is adhesive welded weather tight with manufacturer's recommended adhesive. Include provision for thermal expansion.

3.2.4.4 Stainless Steel Jackets

ASTM A167 or ASTM A240/A240M; Type 304, minimum thickness of 33 gauge (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2 inch.

3.2.5 Below Ground Pipe Insulation

Insulate below ground pipes in accordance with Table 2, except as precluded in subparagraph Pipe Insulation in PART 3. This includes, but is not limited to the following:

a. Heated oil.

b. Domestic hot water.

c. Heating hot water.

d. Dual temperature water.

e. Steam.

f. Condensate.

3.2.5.1 Type of Insulation

Insulate below ground pipe with Cellular Glass insulation, in accordance with manufacturer's instructions for application with thickness as determined from Table 2 (whichever is the most restrictive).

3.2.5.2 Installation of Below ground Pipe Insulation

a. Coat bore surfaces of the insulation with a thin coat of gypsum cement of a type recommended by the insulation manufacturer. Ensure coating thickness is sufficient to fill surface cells of insulation. Do not use mastic type materials for this coating. Note that unless this is for a cyclic application (i.e., one that fluctuates between high and low temperature on a daily process basis) there is no need to bore coat the material.

b. Use stainless steel bands, 3/4 inch wide by 0.020 inch thick to secure insulation in place. Apply a minimum of two bands per section of insulation. As an alternate, fiberglass reinforced tape may be used to secure insulation on piping up to 12 inches in diameter. Apply a minimum of two bands per section of insulation.

c. Terminate insulation at anchor blocks but continue through sleeves and manholes.

d. At point of entry to buildings, terminate underground insulation 2 inches inside the wall or floor, butt tightly against the aboveground insulation and seal the butt joint with high temperature silicone sealant and cover with fibrous glass tape.

e. Make provision for expansion and contraction of the insulation system in accordance with the insulation manufacturer's recommendations.

f. Insulate flanges, couplings, valves, and fittings with factory pre-molded, prefabricated, or field-fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation. Secure insulation sections as recommended by the manufacturer.

g. Finish insulation, including fittings, with three coats of asphaltic mastic, with 6 by 5.5 mesh synthetic reinforcing fabric embedded between coats. Overlap fabric a minimum of 2 inches at joints. Ensure total film thickness is a minimum of 3/16 inch. As an alternate, apply a prefabricated bituminous laminated jacket, reinforced with internal reinforcement mesh, to the insulation. Use jacketing material and application procedures that match manufacturer's written instructions. Vapor barrier - less than 0.0000 permeability self adhesive (minimum 2 mils adhesive, 3 mils embossed) jacket greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty, white or natural). Use application procedures that match the manufacturer's written instructions.

h. At termination points, other than building entrances, use mastic and cloth or tape to cover the ends of insulation and extend 2 inches along the bare pipe.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

Install duct insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions. Duct insulation minimum thickness and insulation level must be as listed in Table 3 and must meet or exceed the requirements ofASHRAE 90.1 - IP.

Except for oven hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces are defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

3.3.1 Duct Insulation Minimum Thickness

Duct insulation minimum thickness in accordance with Table 4.

Table 4 - Minimum Duct Insulation (inches)	
Cold Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Provide insulation and vapor retarder/vapor barrier for the following cold air ducts and associated equipment.

a. Supply ducts.

b. Return air ducts.

c. Relief ducts.

d. Flexible run-outs (field-insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes (field-insulated).

l. Supply fans (field-insulated).

m. Site-erected air conditioner casings.

n. Ducts exposed to weather.

o. Combustion air intake ducts.

Use insulation for rectangular ducts that is flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Provide insulation for both concealed or exposed round/oval ducts that is flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Provide insulation for all exposed ducts with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified. Ensure the total field applied dry film thickness is approximately 1/16 inch. Provide insulation on all concealed duct with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Continue duct insulation through sleeves and prepare openings except firewall penetrations. Duct insulation terminating at fire dampers, must be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Provide duct insulation and vapor retarder/vapor barrier to cover the collar, neck, and un-insulated surfaces of diffusers, registers and grills. Apply vapor retarder/vapor barrier materials to form a complete unbroken vapor seal over the insulation. Seal sheet metal duct in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, attach flexible insulation by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger, additionally secure insulation to bottom of ducts using mechanical fasteners. Space fasteners on 16 inch centers and no more than 16 inches from duct corners.

c. For rectangular, oval and round ducts, provide mechanical fasteners on sides of duct risers for all duct sizes. Space fasteners on 16 inch centers and no more than 16 inches from duct corners.

d. Impale insulation on the mechanical fasteners (self stick pins) where used and press thoroughly into the adhesive. Take care to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. Do not compress insulation to a thickness less than that specified. Carry insulation over standing seams and trapeze-type duct hangers.

e. Where mechanical fasteners are used, install self-locking washers and trim and bend the pin over.

f. Secure jacket overlaps with staples and tape as necessary to ensure a secure seal. Coat staples, tape and seams with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

g. Cover breaks in the jacket material with patches of the same material as the vapor retarder jacket. Do not extend patches less than 2 inches beyond the break or penetration in all directions and secure with tape and staples. Seal staples and tape joints with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

h. At jacket penetrations such as hangers, thermometers, and damper operating rods, fill voids in the insulation and seal the penetration with a brush coat of vapor retarder coating or PVDC adhesive tape greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

i. Seal insulation terminations and pin punctures and flash with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. Ensure the coating overlaps the adjoining insulation and un-insulated surface 2 inches. Extend pin puncture coatings 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, extend insulation under the bracket and terminate the jacket at the bracket.

3.3.2.2 Installation on Exposed Duct Work

a. For rectangular ducts, secure rigid insulation to the duct by mechanical fasteners on all four sides of the duct, space no more than 12 inches apart and no more than 3 inches from the edges of the insulation joints. Provide a minimum of two rows of fasteners for each side of duct 12 inches and larger. Provide one row for each side of duct less than 12 inches. Provide mechanical fasteners that are corrosion resistant as G60 coated galvanized steel, and indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall.

b. Form duct insulation with minimum jacket seams. Fasten each piece of rigid insulation to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, bring insulation up to standing seams, reinforcing, and other vertical projections and do not carry over. Continue vapor retarder/barrier jacket across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, carry over insulation and jacket . Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.

c. Impale insulation on the fasteners; install self-locking washers and trim and bend the pin over.

d. Seal joints in the insulation jacket with a 4 inch wide strip of tape. Seal taped seams with a brush coat of vapor retarder coating.

e. Cover breaks and ribs or standing seam penetrations in the jacket material with a patch of the same material as the jacket. Do not extend patches less than 2 inches beyond the break or penetration and secure with tape and staple. Seal staples and joints with a brush coat of vapor retarder coating.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, fill the voids in the insulation and seal the penetrations with a flashing sealant.

g. Seal and flash insulation terminations and pin punctures with a reinforced vapor retarder coating finish. Ensure coating overlaps the adjoining insulation and un-insulated surface 2 inches. Extend pin puncture coatings 2 inches from the puncture in all directions.

h. Insulate oval and round ducts, flexible type, with factory Type I jacket insulation with minimum density of 3/4 pcf, attach in accordance with MICA standards.

3.3.3 Insulation for Warm Air Duct

Provide insulation and vapor barrier for the following warm air ducts and associated equipment:.

a. Supply ducts.

b. Return air ducts.

c. Relief air ducts

d. Flexible run-outs (field insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil-headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes.

l. Supply fans.

m. Site-erected air conditioner casings.

n. Ducts exposed to weather.

o. Exhaust ducts passing through concealed spaces exhausting conditioned air.

Provide insulation for rectangular ducts that is flexible type where concealed, and rigid type where exposed. Provide insulation on exposed ducts with a white, paint-able, factory-applied Type II jacket, or finish with adhesive finish. Use flexible type insulation for round ducts, with a factory-applied Type II jacket. Provide insulation on concealed duct with a factory-applied Type II jacket. Accomplish adhesive finish where indicated to be used by applying two coats of adhesive with a layer of glass cloth embedded between the coats. Ensure total dry film thickness is approximately 1/16 inch. Continue duct insulation through sleeves and prepare openings. Terminate duct insulation at fire dampers and flexible connections.

3.3.3.1 Installation on Concealed Duct

a. For rectangular, oval and round ducts, attach insulation by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts 24 inches and larger, secure insulation to the bottom of ducts using mechanical fasteners. Space fasteners on 18 inch centers and no more than 18 inches from duct corner.

c. For rectangular, oval and round ducts, provide mechanical fasteners on sides of duct risers for all duct sizes. Space fasteners on 18 inch centers and no more than 18 inches from duct corners.

d. Impale insulation on the mechanical fasteners where used. Do not compress insulation to a thickness less than that specified. Carry insulation over standing seams and trapeze-type hangers.

e. Install self-locking washers where mechanical fasteners are used and trim and bend the pin over.

f. Do not overlap insulatio jacket less than 2 inches at joints and secure the lap and staple on 4 inch centers.

3.3.3.2 Installation on Exposed Duct

a. For rectangular ducts, secure the rigid insulation to the duct using mechanical fasteners on all four sides of the duct, space no more than 16 inches apart and no more than 6 inches from the edges of the insulation joints. Provide a minimum of two rows of fasteners for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.

b. Form duct insulation with factory-applied jacket with minimum jacket seams, and fasten each piece of rigid insulation to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, bring insulation up to standing seams, reinforcing, and other vertical projections and do not carry over the projection. Continue jacket across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, carry insulation and jacket over the projection.

c. Impale insulation on the fasteners; install self-locking washers and trim and bend the pin over.

d. Seal joints on jacketed insulation with a 4 inch wide strip of tape and brush with vapor retarder coating.

e. Cover breaks and penetrations in the jacket material with a patch of the same material as the jacket. Extend patches no less than 2 inches beyond the break or penetration and secure with adhesive and staple.

f. Seal insulation terminations and pin punctures with tape and brush with vapor retarder coating.

g. Insulate oval and round ducts, flexible type, with factory Type I jacket insulation, minimum density of 3/4 pcf attach by staples spaced no more than 16 inches and no more than 6 inches from the degrees of joints. Seal joints in accordance with item "d." above.

3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, insulate ducts as specified for cold air duct.

3.3.5 Insulation for Evaporative Cooling Duct

Insulate evaporative cooling supply duct located in spaces not evaporatively cooled. Use material and installation requirements as specified for duct insulation for warm air duct.

3.3.6 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, repair breaks in the insulation and jacket in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.7 Duct Exposed to Weather

3.3.7.1 Installation

Insulate and finish ducts exposed to weather as specified for the applicable service for exposed duct inside the building. After the above is accomplished, further finish the insulation as detailed in the following subparagraphs.

3.3.7.2 Round Duct

Laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - Less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply, heavy duty, white and natural) membrane must be applied overlapping material by 3 inches no bands or caulking needed - see manufacturer's recommended installation instructions. Aluminum jacket with factory applied moisture retarder must be applied with the joints lapped no less than 3 inches and secured with bands located at circumferential laps and at no more than 12 inch intervals throughout. Lap horizontal joints down to shed water and located at 4 or 8 o'clock position. Seal joints with metal jacketing sealant to prevent moisture penetration. Where jacketing abuts an un-insulated surface, seal joints with metal jacketing sealant.

3.3.7.3 Fittings

Finish fittings and other irregular shapes as specified for rectangular ducts.

3.3.7.4 Rectangular Ducts

Apply two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application to the entire surface. Ensure each coat of weatherproof mastic has a minimum thickness of 1/16 inch. Ensure exterior is a metal jacketing applied for mechanical abuse and weather protection, and secure with screws or vapor barrier/weatherproofing jacket less than 0.0000 permeability greater than 3 ply, standard grade, silver, white, black, and embossed or greater than 8 ply, heavy duty white and natural. Apply membrane overlapping material by 3 inches. No bands or caulking needed-see manufacturing recommend installation instructions.

3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION

Install equipment insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.4.1 General

Provide removable insulation sections to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Omit equipment insulation on the following:

a. Hand-holes.

b. Boiler manholes.

c. Cleanouts.

d. ASME stamps.

e. Manufacturer's nameplates.

f. Duct Test/Balance Test Holes.

3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Furnish insulation on equipment handling media below 60 degrees F including the following:

a. Pumps.

b. Refrigeration equipment parts that are not factory insulated.

c. Drip pans under chilled equipment.

d. Cold water storage tanks.

e. Water softeners.

f. Duct mounted coils.

g. Cold water pumps.

h. Pneumatic water tanks.

i. Roof drain bodies.

j. Air handling equipment parts that are not factory insulated.

k. Expansion and air separation tanks.

3.4.2.1 Insulation Type

Provide insulation suitable for the temperature encountered. Provide material and thicknesses as shown in Table 5:

TABLE 5		
Insulation Thickness for Cold Equipment (inches)		
Equipment handling media at indicated temperature		
	Material	Thickness (inches)
35 to 60 degrees F		
	Cellular Glass	1.5
	Flexible Elastomeric Cellular	1

TABLE 5		
Insulation Thickness for Cold Equipment (inches)		
Equipment handling media at indicated temperature		
	Material	Thickness (inches)
1 to 34 degrees F		
	Cellular Glass	3
	Flexible Elastomeric Cellular	1.5
Minus 30 to 0 degrees F		
	Cellular Glass	3.5
	Flexible Elastomeric Cellular	1.75

3.4.2.2 Pump Insulation

a. Insulate pumps by forming a box around the pump housing. Construct the box by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Join joints between sides and between sides and bottom by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. Ensure box conforms to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Ensure joints between top cover and sides fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.

b. Protect exposed insulation corners with corner angles.

c. Upon completion of installation of the insulation, including removable sections, apply two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish must be 1/16 inch. Provide a parting line between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Apply flashing sealant to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

a. Form or fabricate insulation to fit the equipment. To ensure a tight fit on round equipment, bevel edges and tightly butt and stagger joints.

b. Secure insulation in place with bands or wires at intervals as recommended by the manufacturer but no more than 12 inch centers except adhere flexible elastomeric cellular with contact adhesive. Protect insulation corners under wires and bands with suitable corner angles.

c. Install cellular glass in accordance with manufacturer's instructions. Seal joints and ends with joint sealant, and seal with a vapor retarder coating.

d. Use removable insulation on heads of heat exchangers. Fabricate removable section joints using a male-female shiplap type joint. Finish the entire surface of the removable section by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish must be 1/16 inch.

e. Protect exposed insulation corners with corner angles.

f. Apply insulation on equipment with ribs over 6 by 6 inches by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot weld to the equipment over the ribs. Secure insulation to the fabric with J-hooks and 2 by 2 inches washers or securely band or wire in place on 12 inch centers.

3.4.2.4 Vapor Retarder/Vapor Barrier

Upon completion of installation of insulation, caulk penetrations. Apply two coats of vapor retarder coating or vapor barrier jacket over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. Ensure the total dry thickness of the finish is 1/16 inch. Apply flasing sealant or vapor barrier tape to parting line between equipment and removable section insulation.

3.4.3 Insulation for Hot Equipment

Furnish insulation on equipment handling media above 60 degrees F including the following:

a. Converters.

b. Heat exchangers.

c. Hot water generators.

d. Water heaters.

e. Pumps handling media above 130 degrees F.

f. Fuel oil heaters.

g. Hot water storage tanks.

h. Air separation tanks.

i. Surge tanks.

j. Flash tanks.

k. Feed-water heaters.

l. Unjacketed boilers or parts of boilers.

m. Boiler flue gas connection from boiler to stack (if inside).

n. Induced draft fans.

o. Fly ash and soot collectors.

p. Condensate receivers.

3.4.3.1 Insulation

Provide insulation suitable for the temperature encountered. Insulate shell and tube-type heat exchangers for the temperature of the shell medium.

Determine insulation thickness for hot equipment using Table 6:

TABLE 6		
Insulation Thickness for Hot Equipment (inches)		
Equipment handling steam or media at indicated pressure or temperature limit		
	Material	Thickness (inches)
15 psig or 250 degrees F		
	Rigid Mineral Fiber	2
	Flexible Mineral Fiber	2
	Flexible Elastomeric Cellular (<200 F)	1

3.4.3.2 Insulation of Boiler Stack and Diesel Engine Exhaust Pipe

Inside mechanical Room, bevel insulation neatly around openings and provide sheet metal insulation stop strips around such openings. Apply a skim coat of hydraulic setting cement directly to insulation. Apply a flooding coat of adhesive over hydraulic setting cement, and while still wet, press a layer of glass cloth or tape into adhesive and seal laps and edges with adhesive. Coat glass cloth with adhesive. When dry, apply a finish coat of adhesive at can-consistency so that when dry no glass weave is observed. Provide metal jackets for stacks that are located above finished floor and spaces outside mechanical room. Apply metal jackets directly over insulation and secure with 3/4 inch wide metal bands spaced on 18 inch centers. Do not insulate name plates. Provide insulation type and thickness in accordance with the following Table 7.

TABLE 7						
Insulation and Thickness for Boiler Stack and Diesel Engine Exhaust Pipe						
Service & Surface Temperature Range (Degrees F)						
	Material	Outside Diameter (Inches)				
		0.25 - 1.25	1 - 1.67	3.5-5	6 - 10	> or = 11 - 36
Boiler Stack (Up to 400 degrees F)						
	Mineral Fiber ASTM C585 Class B-3, ASTM C547 Class 1, or ASTM C612 Class 1	N/A	N/A	3	3.5	4
	Calcium Silicate ASTM C533, Type 1	N/A	N/A	3	3.5	4
	Cellular Glass ASTM C552, Type II	1.5	1.5	1.5	2	2.5
Boiler Stack (401 to 600 degrees F)						
	Mineral Fiber ASTM C547 Class 2, ASTM C592 Class 1, or ASTM C612 Class 3	N/A	N/A	4	4	5
	Calcium Silicate ASTM C533, Type I or II	N/A	N/A	4	4	4
	Mineral Fiber/Cellular Glass Composite:					
	Mineral Fiber ASTM C547 Class 2, ASTM C592 Class 1, or ASTM C612 Class 3	1	1	1	1	2

3.4.3.3 Insulation of Pumps

Insulate pumps by forming a box around the pump housing. Construct the box by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Band bottom and sides to form a rigid housing that does not rest on the pump. Ensure joints between top cover and sides fit tightly. The top cover must have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Apply two coats of Class I adhesive over insulation, including removable sections, with a layer of glass cloth embedded between the coats. Provide a parting line between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish must be 1/16 inch. Apply caulking to parting line of the removable sections and penetrations.

3.4.3.4 Other Equipment

a. Form or fabricate insulation to fit the equipment. To ensure a tight fit on round equipment, bevel edges and tightly butt and stagger joints.

b. Secure insulation in place with bands or wires at intervals as recommended by the manufacturer but no greater than 12 inch centers except adhere flexible elastomeric cellular. Protect insulation corners under wires and bands with suitable corner angles.

c. On high vibration equipment, set cellular glass insulation in a coating of bedding compound as recommended by the manufacturer, and seal joints with bedding compound. Fill mineral fiber joints with finishing cement.

d. Provide removable insulation on heads of heat exchangers. Fabricate the removable section joint using a male-female shiplap type joint. Finish the entire surface of the removable section as specified.

e. Protect exposed insulation corners with corner angles.

f. On equipment with ribs, such as boiler flue gas connection, draft fans, and fly ash or soot collectors, apply insulation over 6 by 6 inch by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot weld to the equipment over the ribs. Secure insulation to the fabric with J-hooks and 2 by 2 inch washers or securely band or wire in place on 12 inch (maximum) centers.

g. On equipment handling media above 600 degrees F, apply insulation in two or more layers with staggered joints.

h. Upon completion of installation of insulation, caulk penetrations. Apply two coats of adhesive over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish must be 1/16 inch. Apply caulking to parting line between equipment and removable section insulation.

3.4.4 Equipment Handling Dual Temperature Media

Below and above 60 degrees F: insulate equipment handling dual temperature media as specified for cold equipment.

3.4.5 Equipment Exposed to Weather

3.4.5.1 Installation

Insulate equipment exposed to weather and finish in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

3.4.5.2 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal performance must be equal to or better than that specified for field applied insulation. Provide panels that are the standard catalog product of a manufacturer of metal insulation panels. Provide fastenings, flashing, and support system conforming to published recommendations of the manufacturer for weatherproof installation and that prevent moisture from entering the insulation. Design panels to accommodate thermal expansion and to support a 250 pound walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover sheet must be aluminum and exposed fastenings must be stainless steel or aluminum.

-- End of Section --

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC
02/19, CHG 3: 05/21

PART 1 GENERAL

1.1 SUMMARY

Provide a complete Direct Digital Control (DDC) system suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as indicated and shown and in accordance with Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet or Niagara BACnet systems, and other referenced Sections.

1.1.1 Proprietary Systems

1.1.1.1 Proprietary Systems Exempted From Open Protocol Requirements

The following systems are specifically exempted from the open protocol requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS:

a. A simple split (DX) system consisting of a single indoor unit and a single outdoor unit from the same manufacturer.

b. Systems in Table I (previously approved by the designer in accordance with UFC 3-410-02).

TABLE I: Systems Approved to Use Proprietary Communications

System	Type (Multi-Split/VRF or Chiller/Boiler Plant)	Proprietary Multi-Split Engineering Tool Software Required (for Multi-Split/VRF only)

c. A system (not already shown Table I) of multiple boilers or multiple chillers communicating with a proprietary network for which an approved request has been obtained and for which: all units are from the same manufacturer, they are all co-located in the same room, the network connecting them is fully contained in that room, and the units are operating using a common "plant" sequence of operation which stages the units in a manner that requires operational parameters be shared between them and which cannot be accomplished with a single lead-lag command from a third-party controller.

1.1.1.2 Implementation of Proprietary Systems

For proprietary systems exempted from open protocol requirements, a proprietary network and DDC hardware communicating via proprietary protocol are permitted. For these systems a building control network meeting the requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS must also be provided, along with a gateway or interface to connect the proprietary system to the open building control network.

The proprietary system gateway or interface must provide the required functionaliality as shown on the points schedule. Scheduling, alarming, trending, overrides, network inputs, network outputs and other protocol related requirements must be met on the open protocol control system as specified in Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

1.1.1.3 Proprietary Multi-Split Engineering Tool Software

For each permitted proprietary systems in Table 1 shown as requiring Proprietary Multi-Split Engineering Tool Software, provide the software needed to replace a unit and configure the replacement. Submit hard copies of the software user manuals with the software submittal.

Submit Proprietary Multi-Split Engineering Tool Software on CD-ROM as a Technical Data Package. Submit three hard copies of the software user manual for each piece of software.

1.1.2 System Requirements

Provide systems meeting the requirements this Section and other Sections referenced by this Section, and which have the following characteristics:

a. The system implements the control sequences of operation shown in the Contract Drawings using DDC hardware to control mechanical and electrical equipment

b. The system meet the requirements of this specification as a stand-alone system and does not require connection to any other system.

c. Control sequences reside in DDC hardware in the building. The building control network is not dependent upon connection to a Utility Monitoring and Control System (UMCS) Front End or to any other system for performance of control sequences. To the greatest extent practical, the hardware performs control sequences without reliance on the building network, unless otherwise pre-approved by the Contracting Officer.

d. The hardware is installed such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.

e. All necessary documentation, configuration information, programming tools, programs, drivers, and other software are 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 on the Contractor, Vendor or Manufacturer.

f. Sufficient documentation and data, including rights to documentation and data, are provided such that the Government or their agents can execute work to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the

Contractor, Vendor or Manufacturer.

g. Hardware is installed and configured such that the Government or their agents are able to perform repair, replacement, and upgrades of individual hardware without further interaction with the Contractor, Vendor or Manufacturer.

h. All Niagara Framework components have an unrestricted interoperability license with a Niagara Compatibility Statement (NiCS) following the Tridium Open NiCS Specification and have a value of "ALL" for "Station Compatibility In", "Station Compatibility Out", "Tool Compatibility In" and "Tool Compatibility Out". Note that this will result in the following entries in the license file:

```
accept.station.in="*"
accept.station.out="*"
accept.wb.in="*"
accept.wb.out="*"
```

1.1.3 End to End Accuracy

Select products, install and configure the system such that the maximum error of a measured value as read from the DDC Hardware over the network is less than the maximum allowable error specified for the sensor or instrumentation.

1.1.4 Verification of Dimensions

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.1.5 Drawings

The Government will not indicate all offsets, fittings, and accessories that may be required on the drawings. Carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, arrange such work accordingly, and provide all work necessary to meet such conditions.

1.2 RELATED SECTIONS

Related work specified elsewhere:

a. Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet systems with or without Niagara Framework.

b. Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

c. Section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

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

ASHRAE 135	(2020; Interpretation 1-8 2021; Errata 1-2 2021; Addenda CD 2021; Addenda BY-CE 2022; Interpretation 9-10 2022) BACnet—A Data Communication Protocol for Building Automation and Control Networks
ASHRAE FUN IP	(2021) Fundamentals Handbook, I-P Edition
ASHRAE FUN SI	(2021) Fundamentals Handbook, SI Edition

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code
NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems

TRIDIUM, INC (TRIDIUM)

Niagara Framework	(2012) NiagaraAX User's Guide
Tridium Open NiCS	(2005) Understanding the NiagaraAX Compatibility Statement (NiCS)

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-410-02	(2018; with Change 2, 2021) Direct Digital Control for HVAC and Other Building Control Systems

UNDERWRITERS LABORATORIES (UL)

UL 5085-3	(2006; Reprint Jan 2022) UL Standard for Safety Low Voltage Transformers - Part 3: Class 2 and Class 3 Transformers

1.4 DEFINITIONS

The following list of definitions includes terms used in Sections referenced by this Section and are included here for completeness.The definitions contained in this Section may disagree with how terms are defined or used in other documents, including documents referenced by this Section. The definitions included here are the authoritative definitions for this Section and all Sections referenced by this Section.

After each term the protocol related to that term is included in parenthesis.

1.4.1 Alarm Generation (All protocols)

Alarm Generation is the monitoring of a value, comparison of the value to alarm conditions and the creation of an alarm when the conditions set for the alarm are met. Note that this does NOT include delivery of the alarm to the final destination (such as a user interface).

1.4.2 Building Automation and Control Network (BACnet) (BACnet)

The term BACnet is used in two ways. First meaning the BACnet Protocol Standard - the communication requirements as defined by ASHRAE 135 including all annexes and addenda. The second to refer to the overall technology related to the ASHRAE 135 protocol.

1.4.3 BACnet Advanced Application Controller (B-AAC) (BACnet)

A hardware device BTL Listed as a B-AAC, which is required to support BACnet Interoperability Building Blocks (BIBBs) for scheduling and alarming, but is not required to support as many BIBBs as a B-BC.

1.4.4 BACnet Application Specific Controller (B-ASC) (BACnet)

A hardware device BTL Listed as a B-ASC, with fewer BIBB requirements than a B-AAC. It is intended for use in a specific application.

1.4.5 BACnet Building Controller (B-BC) (BACnet)

A hardware device BTL Listed as a B-BC. A general-purpose, field-programmable device capable of carrying out a variety of building automation and control tasks including control and monitoring via direct digital control (DDC) of specific systems and data storage for trend information, time schedules, and alarm data. Like the other BTL Listed controller types (B-AAC, B-ASC etc.) a B-BC device is required to support the server ("B") side of the ReadProperty and WriteProperty services, but unlike the other controller types it is also required to support the client ("A") side of these services. Communication between controllers requires that one of them support the client side and the other support the server side, so a B-BC is often used when communication between controllers is needed.

1.4.6 BACnet Broadcast Management Device (BBMD) (BACnet)

A communications device, typically combined with a BACnet router. A BBMD forwards BACnet broadcast messages to BACnet/IP devices and other BBMDs connected to the same BACnet/IP network. Each IP subnet that is part of a BACnet/IP network must have at least one BBMD. Note there are additional restrictions when multiple BBMDs share an IP subnet.

1.4.7 BACnet/IP (BACnet)

An extension of BACnet, Annex J, defines the use of a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnets that share the same BACnet network number. See also paragraph BACNET BROADCAST MANAGEMENT DEVICE.

1.4.8 BACnet Internetwork (BACnet)

Two or more BACnet networks, connected with BACnet routers. In a BACnet Internetwork, there exists only one message path between devices.

1.4.9 BACnet Interoperability Building Blocks (BIBBs) (BACnet)

A BIBB is a collection of one or more ASHRAE 135 Services intended to define a higher level of interoperability. BIBBs are combined to build the BACnet functional requirements for a device in a specification. Some BIBBs define additional requirements (beyond requiring support for specific services) in order to achieve a level of interoperability. For example, the BIBB DS-V-A (Data Sharing-View-A), which would typically be used by a front-end, not only requires the client to support the ReadProperty Service, but also provides a list of data types (Object / Properties) which the client must be able to interpret and display for the user.

In the BIBB shorthand notation, -A is the client side and -B is the server side.

The following is a list of some BIBBs used by this or referenced Sections:	
DS-COV-A	Data Sharing-Change of Value (A side)
DS-COV-B	Data Sharing-Change of Value (B side)
NM-RC-B	Network Management-Router Configuration (B side)
DS-RP-A	Data Sharing-Read Property (A side)
DS-RP-B	Data Sharing-Read Property (B side)
DS-RPM-A	Data Sharing-Read Property Multiple (A Side)
DS-RPM-B	Data Sharing-Read Property Multiple (B Side)
DS-WP-A	Data Sharing-Write Property (A Side)
DM-TS-B	Device Management-Time Synchronization (B Side)
DM-UTC-B	Device Management-UTC Time Synchronization (B Side)
DS-WP-B	Data Sharing-Write Property (B side)
SCHED-E-B	Scheduling-External (B side)
DM-OCD-B	Device Management-Object Creation and Deletion (B side)
AE-N-I-B	Alarm and Event-Notification Internal (B Side)
AE-N-E-B	Alarm and Event-Notification External (B Side)
T-VMT-I-B	Trending-Viewing and Modifying Trends Internal (B Side)

The following is a list of some BIBBs used by this or referenced Sections:	
T-VMT-E-B	Trending-Viewing and Modifying Trends External (B Side)

1.4.10 BACnet Network (BACnet)

In BACnet, a portion of the control Internetwork consisting of one or more segments connected by repeaters. Networks are separated by routers.

1.4.11 BACnet Operator Display (B-OD) (BACnet)

A basic operator interface with limited capabilities relative to a B-OWS. It is not intended to perform direct digital control. A B-OD profile could be used for LCD devices, displays affixed to BACnet devices, handheld terminals or other very simple user interfaces.

1.4.12 BACnet Segment (BACnet)

One or more physical segments interconnected by repeaters (ASHRAE 135).

1.4.13 BACnet Smart Actuator (B-SA) (BACnet)

A simple actuator device with limited resources intended for specific applications.

1.4.14 BACnet Smart Sensor (B-SS) (BACnet)

A simple sensing device with limited resources.

1.4.15 BACnet Testing Laboratories (BTL) (BACnet)

Established by BACnet International to support compliance testing and interoperability testing activities and consists of BTL Manager and the BTL Working Group (BTL-WG). BTL also publishes Implementation Guidelines.

1.4.16 BACnet Testing Laboratories (BTL) Listed (BACnet)

A device that has been listed by BACnet Testing Laboratory. Devices may be certified to a specific device profile, in which case the listing indicates that the device supports the required capabilities for that profile, or may be listed as "other".

1.4.17 Binary (All protocols)

A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level. 'Digital' is sometimes used interchangeably with 'binary'.

1.4.18 Broadcast (BACnet)

Unlike most messages, which are intended for a specific recipient device, a broadcast message is intended for all devices on the network.

1.4.19 Building Control Network (BCN) (All protocols)

The network connecting all DDC Hardware within a building (or specific group of buildings).

1.4.20 Building Point of Connection (BPOC) (All protocols)

A FPOC for a Building Control System. (This term is being phased out of use in preference for FPOC but is still used in some specifications and criteria. When it was used, it typically referred to a piece of control hardware. The current FPOC definition typically refers instead to IT hardware.)

1.4.21 Commandable (All protocols)

See Overridable.

1.4.22 Commandable Objects (BACnet)

Commandable Objects have a Commandable Property, Priority_Array, and Relinquish_Default Property as defined in ASHRAE 135, Clause 19.2, Command Prioritization.

1.4.23 Configurable (All protocols)

A property, setting, or value is configurable if it can be changed via hardware settings on the device, via the use of engineering software or over the control network from the front end, and is retained through (after) loss of power.

In a Niagara Framework BACnet system, a property, setting, or value is configurable if it can be changed via one or more of:

1) via BACnet services (including proprietary BACnet services)
2) via hardware settings on the device
3) via the Niagara Framework

Note this is more stringent than the ASHRAE 135 definition.

1.4.24 Control Logic Diagram (All protocols)

A graphical representation of control logic for multiple processes that make up a system.

1.4.25 Device (BACnet)

A Digital Controller that contains a BACnet Device Object and uses BACnet to communicate with other devices.

1.4.26 Device Object (BACnet)

Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object requires a unique Object Identifier number on the BACnet Internetwork. This number is often referred to as the device instance or device ID.

1.4.27 Device Profile (BACnet)

A collection of BIBBs determining minimum BACnet capabilities of a device, defined in ASHRAE 135. Standard device profiles include BACnet Advanced Workstations (B-AWS), BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS).

1.4.28 Digital Controller (All protocols)

An electronic controller, usually with internal programming logic and digital and analog input/output capability, which performs control functions.

1.4.29 Direct Digital Control (DDC) (All protocols)

Digital controllers performing control logic. Usually the controller directly senses physical values, makes control decisions with internal programs, and outputs control signals to directly operate switches, valves, dampers, and motor controllers.

1.4.30 Field Point of Connection (FPOC) (All protocols)

The FPOC is the point of connection between the UMCS IP Network and the field control network (either an IP network, a non-IP network, or a combination of both). The hardware at this location which provides the connection is generally an IT device such as a switch, IP router, or firewall.

In general, the term "FPOC Location" means the place where this connection occurs, and "FPOC Hardware" means the device that provides the connection. Sometimes the term "FPOC" is used to mean either and its actual meaning (i.e. location or hardware) is determined by the context in which it is used.

1.4.31 Fox Protocol (Niagara Framework)

The protocol used for communication between components in the Niagara Framework. By default, Fox uses TCP port 1911.

1.4.32 Gateway (All protocols)

A device that translates from one protocol application data format to another. Devices that change only the transport mechanism of the protocol - "translating" from TP/FT-10 to Ethernet/IP or from BACnet MS/TP to BACnet over IP for example - are not gateways as the underlying data format does not change. Gateways are also called Communications Bridges or Protocol Translators.

A Niagara Framework Supervisory Gateway is one type of Gateway.

1.4.33 IEEE 802.3 Ethernet (All protocols)

A family of local-area-network technologies providing high-speed networking features over various media, typically Cat 5, 5e or Cat 6 twisted pair copper or fiber optic cable.

1.4.34 Internet Protocol (IP, TCP/IP, UDP/IP) (All protocols)

A communication method, the most common use is the World Wide Web. At the lowest level, it is based on Internet Protocol (IP), a method for conveying and routing packets of information over various LAN media. Two common protocols using IP are User Datagram Protocol (UDP) and Transmission Control Protocol (TCP). UDP conveys information to well-known "sockets" without confirmation of receipt. TCP establishes connections, also known as "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

1.4.35 Input/Output (I/O) (All protocols)

Physical inputs and outputs to and from a device, although the term sometimes describes network or "virtual" inputs or outputs. See also "Points".

1.4.36 I/O Expansion Unit (All protocols)

An I/O expansion unit provides additional point capacity to a digital controller

1.4.37 IP subnet (All protocols)

A group of devices which share a defined range IP addresses. Devices on a common IP subnet can share data (including broadcasts) directly without the need for the traffic to traverse an IP router.

1.4.38 JACE (Niagara Framework)

Java Application Control Engine. See paragraph NIAGARA FRAMEWORK SUPERVISORY GATEWAY

1.4.39 Local-Area Network (LAN) (All protocols)

A communication network that spans a limited geographic area and uses the same basic communication technology throughout.

1.4.40 Local Display Panels (LDPs) (All protocols)

A DDC Hardware with a display and navigation buttons, and must provide display and adjustment of points as shown on the Points Schedule and as indicated.

1.4.41 MAC Address (All protocols)

Media Access Control address. The physical device address that identifies a device on a Local Area Network.

1.4.42 Master-Slave/Token-Passing (MS/TP) (BACnet)

Data link protocol as defined by the BACnet standard. Multiple speeds (data rates) are permitted by the BACnet MS/TP standard.

1.4.43 Monitoring and Control (M&C) Software (All protocols)

The UMCS 'front end' software which performs supervisory functions such as alarm handling, scheduling and data logging and provides a user interface for monitoring the system and configuring these functions.

1.4.44 Network Number (BACnet)

A site-specific number assigned to each network. This network number must be unique throughout the BACnet Internetwork.

1.4.45 Niagara Framework (Niagara Framework)

A set of hardware and software specifications for building and utility control owned by Tridium Inc. and licensed to multiple vendors. The

Framework consists of front end (M&C) software, web based clients, field level control hardware, and engineering tools. While the Niagara Framework is not adopted by a recognized standards body and does not use an open licensing model, it is sufficiently well-supported by multiple HVAC vendors to be considered a de-facto Open Standard.

1.4.46 Niagara Framework Supervisory Gateway (Niagara Framework)

DDC Hardware component of the Niagara Framework. A typical Niagara architecture has Niagara specific supervisory gateways at the IP level and other (non-Niagara specific) controllers on field networks (TP/FT-10, MS/TP, etc.) beneath the Niagara supervisory gateways. The Niagara specific controllers function as a gateway between the Niagara framework protocol (Fox) and the field network beneath. These supervisory gateways may also be used as general purpose controllers and also have the capability to provide a web-based user interface.

Note that different vendors refer to this component by different names. The most common name is "JACE"; other names include (but are not limited to)"EC-BOS", "FX-40", "TMN", "SLX" and "UNC".

1.4.47 Object (BACnet)

An ASHRAE 135 Object. The concept of organizing BACnet information into standard components with various associated Properties. Examples include Analog Input objects and Binary Output objects.

1.4.48 Object Identifier (BACnet)

A grouping of two Object properties: Object Type (e.g. Analog Value, Schedule, etc.) and Object Instance (in this case, a number). Object Identifiers must be unique within a device.

1.4.49 Object Instance (BACnet)

See paragraph OBJECT IDENTIFIER

1.4.50 Object Properties (BACnet)

Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.

1.4.51 Operator Configurable (All protocols)

Operator configurable values are values that can be changed from a single common front end user interface across multiple vendor systems.

For Niagara Framework Systems, a property, setting, or value is Operator Configurable when it is configurable from a Niagara Framework Front End.

1.4.52 Override (All protocols)

Changing the value of a point outside of the normal sequence of operation where the change has priority over the sequence and where there is a mechanism for releasing the change such that the point returns to the normal value. Overrides persist until released or overridden at the same or higher priority but are not required to persist through a loss of power. Overrides are often used by operators to change values, and generally originate at a user interface (workstation or local display panel).

1.4.53 Packaged Equipment (All protocols)

Packaged equipment is a single piece of equipment provided by a manufacturer in a substantially complete and operable condition, where the controls (DDC Hardware) are factory installed, and the equipment is sold and shipped from the manufacturer as a single entity. Disassembly and reassembly of a large piece of equipment for shipping does not prevent it from being packaged equipment. Package units may require field installation of remote sensors. Packaged equipment is also called a "packaged unit".

Note industry may use the term "Packaged System" to mean a collection of equipment that is designed to work together where each piece of equipment is packaged equipment and there is a network that connects the equipment together. A "packaged system" of this type is NOT packaged equipment; it is a collection of packaged equipment, and each piece of equipment must individually meet specification requirements.

1.4.54 Packaged Unit (All protocols)

See packaged equipment.

1.4.55 Performance Verification Test (PVT) (All protocols)

The procedure for determining if the installed BAS meets design criteria prior to final acceptance. The PVT is performed after installation, testing, and balancing of mechanical systems. Typically the PVT is performed by the Contractor in the presence of the Government.

1.4.56 Physical Segment (BACnet)

A single contiguous medium to which BACnet devices are attached (ASHRAE 135).

1.4.57 Polling (All protocols)

A device periodically requesting data from another device.

1.4.58 Points (All protocols)

Physical and virtual inputs and outputs. See also paragraph INPUT/OUTPUT (I/O).

1.4.59 Proportional, Integral, and Derivative (PID) Control Loop (All protocols)

Three parameters used to control modulating equipment to maintain a setpoint. Derivative control is often not required for HVAC systems (leaving "PI" control).

1.4.60 Proprietary (BACnet)

Within the context of BACnet, any extension of or addition to object types, properties, PrivateTransfer services, or enumerations specified in ASHRAE 135. Objects with Object_Type values of 128 and above are

Proprietary Objects. Properties with Property_Identifier of 512 and above are proprietary Properties.

1.4.61 Protocol Implementation Conformance Statement (PICS) (BACnet)

A document, created by the manufacturer of a device, which describes which portions of the BACnet standard may be implemented by a given device. ASHRAE 135 requires that all ASHRAE 135 devices have a PICS, and also defines a minimum set of information that must be in it. A device as installed for a specific project may not implement everything in its PICS.

1.4.62 Repeater (All protocols)

A device that connects two control network segments and retransmits all information received on one side onto the other.

1.4.63 Router (All protocols)

A device that connects two ASHRAE 135 networks and controls traffic between the two by retransmitting signals received from one side onto the other based on the signal destination. Routers are used to subdivide a BACnet internetwork and to limit network traffic.

1.4.64 Segment (All protocols)

A 'single' section of a control network that contains no repeaters or routers. There is generally a limit on the number of devices on a segment, and this limit is dependent on the topology/media and device type.

1.4.65 Standard BACnet Objects (BACnet)

Objects with Object_Type values below 128 and specifically enumerated in Clause 21 of ASHRAE 135. Objects which are not proprietary. See paragraph PROPRIETARY.

1.4.66 Standard BACnet Properties (BACnet)

Properties with Property_Identifier values below 512 and specifically enumerated in Clause 21 of ASHRAE 135. Properties which are not proprietary. See Proprietary.

1.4.67 Standard BACnet Services (BACnet)

ASHRAE 135 services other than ConfirmedPrivateTransfer or UnconfirmedPrivateTransfer. See paragraph PROPRIETARY.

1.4.68 UMCS (All protocols)

UMCS stands for Utility Monitoring and Control System. The term refers to all components by which a project site monitors, manages, and controls real-time operation of HVAC and other building systems. These components include the UMCS "front-end" and all field building control systems connected to the front-end. The front-end consists of Monitoring and Control Software (user interface software), browser-based user interfaces and network infrastructure.

The network infrastructure (the "UMCS Network"), is an IP network connecting multiple building or facility control networks to the

Monitoring and Control Software.

1.4.69 UMCS Network (All protocols)

The UMCS Network connects multiple building or facility control networks to the Monitoring and Control Software.

1.4.70 Writable Property (BACnet)

A Property is Writable when it can be changed through the use of one or more of the WriteProperty services defined in ASHRAE 135, Clause 15 regardless of the value of any other Property. Note that in the ASHRAE 135 standard, some Properties may be writable when the Out of Service Property is TRUE; for purposes of this Section, Properties that are only writable when the Out of Service Property is TRUE are not considered to be Writable.

1.5 PROJECT SEQUENCING

TABLE II: PROJECT SEQUENCING lists the sequencing of submittals as specified in paragraph SUBMITTALS (denoted by an 'S' in the 'TYPE' column) and activities as specified in PART 3 EXECUTION (denoted by an 'E' in the 'TYPE' column). TABLE II does not specify overall project milestone and completion dates.

a. Sequencing for Submittals: The sequencing specified for submittals is the deadline by which the submittal must be initially submitted to the Government. Following submission there will be a Government review period as specified in Section 01 33 00 SUBMITTAL PROCEDURES. If the submittal is not accepted by the Government, revise the submittal and resubmit it to the Government within 14 days of notification that the submittal has been rejected. Upon resubmittal there will be an additional Government review period. If the submittal is not accepted the process repeats until the submittal is accepted by the Government.

b. Sequencing for Activities: The sequencing specified for activities indicates the earliest the activity may begin.

c. Abbreviations: In TABLE II the abbreviation AAO is used for 'after approval of' and 'ACO' is used for 'after completion of'.

TABLE II. PROJECT SEQUENCING

ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL)
1	S	Existing Conditions Report	
2	S	DDC Contractor Design Drawings	
3	S	Manufacturer's Product Data	
4	S	Pre-construction QC Checklist	
5	E	Install Building Control System	AAO #1 thru #4

TABLE II. PROJECT SEQUENCING

ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL)
6	E	Start-Up and Start-Up Testing	ACO #5
7	S	Post-Construction QC Checklist	ACO #6
8	S	Programming Software Configuration Software Niagara Framework Engineering Tool Niagara Framework Wizards	ACO #6
9	S	Draft As-Built Drawings	ACO #6
10	S	Start-Up Testing Report	ACO #6
11	S	PVT Procedures	before schedule start of #12 and AAO #10
12	E	Execute PVT	AAO #9 and #11
13	S	PVT Report	ACO #12
14	S	Controller Application Programs Controller Configuration Settings Niagara Framework Supervisory Gateway Backups	AAO #13
15	S	Final As-Built Drawings	AAO #13
16	S	O&M Instructions	AAO #15

TABLE II. PROJECT SEQUENCING

ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL)
17	S	Training Documentation	AAO #10 and before scheduled start of #18
18	E	Training	AAO #16 and #17
19	S	Closeout QC Checklist	ACO #18

1.6 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

DDC Contractor Design Drawings; G

Draft As-Built Drawings; G

Final As-Built Drawings; G

SD-03 Product Data

Programming Software; G

Controller Application Programs; G

Configuration Software; G

Controller Configuration Settings; G

Proprietary Multi-Split Engineering Tool Software; G

Manufacturer's Product Data; G

Niagara Framework Supervisory Gateway Backups; G

Niagara Framework Engineering Tool; G

SD-05 Design Data

Boiler Or Chiller Plant Gateway Request

SD-06 Test Reports

Pre-Construction Quality Control (QC) Checklist; G

Post-Construction Quality Control (QC) Checklist; G

Start-Up Testing Report; G

PVT Procedures; G

PVT Report; G

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G

Training Documentation; G

SD-11 Closeout Submittals

Enclosure Keys; G

Password Summary Report; G

Closeout Quality Control (QC) Checklist; G

1.7 DATA PACKAGE AND SUBMITTAL REQUIREMENTS

Technical data packages consisting of technical data and computer software (meaning technical data which relates to computer software) which are specifically identified in this project and which may be defined/required in other specifications must be delivered strictly in accordance with the CONTRACT CLAUSES and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered must be identified by reference to the particular specification paragraph against which it is furnished. All submittals not specified as technical data packages are considered 'shop drawings' under the Federal Acquisition Regulation Supplement (FARS) and must contain no proprietary information and be delivered with unrestricted rights.

1.8 SOFTWARE FOR DDC HARDWARE AND GATEWAYS

Provide all software related to the programming and configuration of DDC Hardware and Gateways as indicated. License all Software to the project site. The term "controller" as used in these requirements means both DDC Hardware and Gateways.

1.8.1 Configuration Software

For each type of controller, provide the configuration tool software in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. Submit hard copies of the software user manuals for each software with the software submittal.

Submit Configuration Software on CD-ROM as a Technical Data Package. Submit three hard copies of the software user manual for each piece of software.

1.8.2 Controller Configuration Settings

For each controller, provide copies of the installed configuration settings as source code compatible with the configuration tool software for that controller in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

Submit Controller Configuration Settings on CD-ROM as a Technical Data Package. Include on the CD-ROM a list or table of contents clearly indicating which files are associated with each device. Submit 2 copies of the Controller Configuration Settings CD-ROM.

1.8.3 Programming Software

For each type of programmable controller, provide the programming software in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. Submit hard copies of software user manuals for each software with the software submittal.

Submit Programming Software on CD-ROM as a Technical Data Package. Submit three hard copies of the software user manual for each piece of software.

1.8.4 Controller Application Programs

For each programmable controller, provide copies of the application program as source code compatible with the programming software for that controller in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

Submit Controller Application Programs on CD-ROM as a Technical Data Package. Include on the CD-ROM a list or table of contents clearly indicating which application program is associated with each device. Submit 2 copies of the Controller Application Programs CD-ROM.

1.8.5 Niagara Framework Supervisory Gateway Backups

For each Niagara Framework Supervisory Gateway, provide a backup of all software within the Niagara Framework Supervisory Gateway, including configuration settings. This backup must be sufficient to allow the restoration of the Niagara Framework Supervisory Gateway or the replacement of the Niagara Framework Supervisory Gateway.

Submit backups for each Niagara Framework Supervisory Gateway on CD-ROM as a Technical Data Package. Mark each backup indicating clearly the source Niagara Framework Supervisory Gateway.

1.8.6 Niagara Framework Engineering Tool(for all Niagara Framework system)

Provide a Niagara Framework Engineering Tool in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. Submit software user manuals with the Niagara Framework Engineering Tool submittal.

Submit the Niagara Framework Engineering Tool on CD-ROM as a Technical Data Package. Submit three hard copies of the software user manual for the Niagara Framework Engineering Tool.

1.9 BOILER OR CHILLER PLANT GATEWAY REQUEST

If requesting the use of a gateway to a boiler or chiller plant as indicated in paragraph Proprietary Systems Exempted From Open Protocol Requirements, submit a Boiler or Chiller Plant Gateway Request describing the configuration of the boilers or chillers including model numbers for equipment and controllers, the sequence of operation for the units, and a justification for the need to operate the units on a shared non-BACnet network.

1.10 QUALITY CONTROL CHECKLISTS

The QC Checklist for Niagara Framework Based BACnet Systems in APPENDIX A of this Section must be completed by the Contractor's Chief Quality Control (QC) Representative and submitted as indicated.

The QC Representative must verify each item indicated and initial in the space provided to indicate that the requirement has been met. The QC Representative must sign and date the Checklist prior to submission to the Government.

1.10.1 Pre-Construction Quality Control (QC) Checklist

Complete items indicated as Pre-Construction QC Checklist items in the QC Checklist. Submit four copies of the Pre-Construction QC Checklist.

1.10.2 Post-Construction Quality Control (QC) Checklist

Complete items indicated as Post-Construction QC Checklist items in the QC Checklist. Submit four copies of the Post-Construction QC Checklist.

1.10.3 Closeout Quality Control (QC) Checklist

Complete items indicated as Closeout QC Checklist items in the QC Checklist. Submit four copies of the Closeout QC Checklist.

PART 2 PRODUCTS

Provide products meeting the requirements of Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet or Niagara BACnet systems, other referenced Sections, and this Section.

2.1 GENERAL PRODUCT REQUIREMENTS

Units of the same type of equipment must be products of a single manufacturer. Each major component of equipment must have the manufacturer's name and address, and the model and serial number in a conspicuous place. Materials and equipment must be standard products of a manufacturer regularly engaged in the manufacturing of these and similar products. The standard products must have been in a satisfactory commercial or industrial use for two years prior to use on this project. The two year use must include applications of equipment and materials under similar circumstances and of similar size. DDC Hardware not meeting the two-year field service requirement is acceptable provided it has been successfully used by the Contractor in a minimum of two previous projects. The equipment items must be supported by a service organization. Items of the same type and purpose must be identical, including equipment, assemblies, parts and components.

2.2 PRODUCT DATA

Provide manufacturer's product data sheets documenting compliance with product specifications for each product provided under Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS, or this Section. Provide product data for all products in a single indexed compendium, organized by product type.

For all BACnet hardware: for each manufacturer, model and version (revision) of DDC Hardware provide the Protocol Implementation Conformance Statement (PICS) in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

Submit Manufacturer's Product Data on CD-ROM.

2.3 OPERATION ENVIRONMENT

Unless otherwise specified, provide products rated for continuous operation under the following conditions:

a. Pressure: Pressure conditions normally encountered in the installed location.

b. Vibration: Vibration conditions normally encountered in the installed location.

c. Temperature:

  (1) Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.

  (2) Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of 0 to 120 degrees F and temperature conditions outside this range normally encountered at the installed location.

d. Humidity: 10 to 95 percent relative humidity, noncondensing and humidity conditions outside this range normally encountered at the installed location.

2.4 WIRELESS CAPABILITY

For products incorporating any wireless capability (including but not limited to radio frequency (RF), infrared and optical), provide products for which wireless capability can be permanently disabled at the device. Optical and infrared capabilities may be disabled via a permanently affixed opaque cover plate.

2.5 ENCLOSURES

Enclosures supplied as an integral (pre-packaged) part of another product are acceptable. Provide two Enclosure Keys for each lockable enclosure on a single ring per enclosure with a tag identifying the enclosure the keys operate. Provide enclosures meeting the following minimum requirements:

2.5.1 Outdoors

For enclosures located outdoors, provide enclosures meeting NEMA 250 Type 4 requirements.

2.5.2 Mechanical and Electrical Rooms

For enclosures located in mechanical or electrical rooms, provide enclosures meeting NEMA 250 Type 2 requirements.

2.5.3 Other Locations

For enclosures in other locations including but not limited to occupied spaces, above ceilings, and in plenum returns, provide enclosures meeting NEMA 250 Type 1 requirements.

2.6 WIRE AND CABLE

Provide wire and cable meeting the requirements of NFPA 70 and NFPA 90A in addition to the requirements of this specification and referenced specifications.

2.6.1 Terminal Blocks

For terminal blocks which are not integral to other equipment, provide terminal blocks which are insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, suitable for DIN rail mounting, and which have enclosed sides or end plates and partition plates for separation.

2.6.2 Control Wiring for Binary Signals

For Control Wiring for Binary Signals, provide 18 AWG copper or thicker wire rated for 300-volt service.

2.6.3 Control Wiring for Analog Signals

For Control Wiring for Analog Signals, provide 18 AWG or thicker, copper, single- or multiple-twisted wire meeting the following requirements:

a. minimum 2 inch lay of twist

b. 100 percent shielded pairs

c. at least 300-volt insulation

d. each pair has a 20 AWG tinned-copper drain wire and individual overall pair insulation

e. cables have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.6.4 Power Wiring for Control Devices

For 24-volt circuits, provide insulated copper 18 AWG or thicker wire rated for 300 VAC service. For 120-volt circuits, provide 14 AWG or thicker stranded copper wire rated for 600-volt service.

2.6.5 Transformers

Provide UL 5085-3 approved transformers. Select transformers sized so that the connected load is no greater than 80 percent of the transformer rated capacity.

PART 3 EXECUTION

3.1 INSTALLATION

Fully install and test the control system in accordance Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet or Niagara BACnet systems, and this Section.

3.1.1 Dielectric Isolation

Provide dielectric isolation where dissimilar metals are used for connection and support. Install control system in a matter that provides clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. Install control system such that it does not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.2 Penetrations in Building Exterior

Make all penetrations through and mounting holes in the building exterior watertight.

3.1.3 Device Mounting Criteria

Install devices in accordance with the manufacturer's recommendations and as indicated and shown. Provide a weathershield for all devices installed outdoors. Provide clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. Provide clearance for mechanical and electrical system maintenance; do not not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.4 Labels and Tags

Key all labels and tags to the unique identifiers shown on the As-Built drawings. For labels exterior to protective enclosures provide engraved plastic labels mechanically attached to the enclosure or DDC Hardware. Labels inside protective enclosures may be attached using adhesive, but must not be hand written. For tags, provide plastic or metal tags mechanically attached directly to each device or attached by a metal chain or wire.

a. Label all Enclosures and DDC Hardware.

b. Tag Airflow measurement arrays (AFMA) with flow rate range for signal output range, duct size, and pitot tube AFMA flow coefficient.

c. Tag duct static pressure taps at the location of the pressure tap

3.1.5 Surge Protection

3.1.5.1 Power-Line Surge Protection

Protect equipment connected to AC circuits to withstand power-line surges in accordance with IEEE C62.41. Do not use fuses for surge protection.

3.1.5.2 Surge Protection for Transmitter and Control Wiring

Protect DDC hardware against or provided DDC hardware capable of withstanding surges induced on control and transmitter wiring installed outdoors and as shown. Protect equipment against the following two waveforms:

a. A waveform with a 10-microsecond rise time, a 1000-microsecond decay time and a peak current of 60 amps.

b. A waveform with an 8-microsecond rise time, a 20-microsecond decay time and a peak current of 500 amperes.

3.1.6 Basic Cybersecurity Requirements

3.1.6.1 Passwords

For all devices with a password, change the password from the default password. Do not use the same password for more than one device. Coordinate selection of passwords with Base Controls Shop. Provide a Password Summary Report documenting the password for each device and describing the procedure to change the password for each device.

Provide two hardcopies of the Password Summary Report, each copy in its own sealed envelope.

3.1.6.2 Wireless Capability

Unless otherwise indicated, disable wireless capability (including but not limited to radio frequency (RF), infrared and optical) for all devices with wireless capability. Optical and infrared capabilities may be disabled via a permanently affixed opaque cover plate. Password protecting a wireless connections does not meet this requirement; the wireless capability must be disabled.

3.1.6.3 IP Network Physical Security

Install all IP Network media in conduit. Install all IP devices including but not limited to IP-enabled DDC hardware and IP Network Hardware in lockable enclosures.

3.2 DRAWINGS AND CALCULATIONS

Provide drawings in the form and arrangement indicated and shown. Use the same abbreviations, symbols, nomenclature and identifiers shown. Assign a unique identifier as shown to each control system element on a drawing. When packaging drawings, group schedules by system. When space allows, it is permissible to include multiple schedules for the same system on a single sheet. Except for drawings covering all systems, do not put information for different systems on the same sheet.

Submit hardcopy drawings on 36 by 24 inches and 18 by 12 inches sheets, and electronic drawings in PDF and in AutoCAD format. In addition, submit electronic drawings in editable Excel format for all drawings that are tabular, including but not limited to the Point Schedule and Equipment Schedule.

a. Submit DDC Contractor Design Drawings consisting of each drawing indicated with pre-construction information depicting the intended control system design and plans. Submit DDC Contractor Design Drawings as a single complete package: three hard copies and three copies on CD-ROM.

b. Submit Draft As-Built Drawings consisting of each drawing indicated updated with as-built data for the system prior to PVT. Submit Draft As-Built Drawings as a single complete package: three hard copies and three copies on CD-ROM.

c. Submit Final As-Built Drawings consisting of each drawing indicated updated with all final as-built data. Final As-Built Drawings as a single complete package: three hard copies and three copies on CD-ROM.

3.2.1 Sample Drawings

Sample drawings in electronic format are available at the Whole Building Design Guide page for this section:
http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-23-09-00
These drawings may prove useful in demonstrating expected drawing formatting and example content and are provided for illustrative purposes only. Note that these drawings do not meet the content requirements of this Section and must be completed to meet project requirements.

3.2.2 Drawing Index and Legend

Provide an HVAC Control System Drawing Index showing the name and number of the building, military site, State or other similar designation, and Country. In the Drawing Index, list all Contractor Design Drawings, including the drawing number, sheet number, drawing title, and computer filename when used. In the Design Drawing Legend, show and describe all symbols, abbreviations and acronyms used on the Design Drawings. Provide a single Index and Legend for the entire drawing package.

3.2.3 Thermostat and Occupancy Sensor Schedule

Provide a thermostat and occupancy sensor schedule containing each thermostat's unique identifier, room identifier and control features and functions as shown. Provide a single thermostat and occupancy sensor schedule for the entire project.

3.2.4 Valve Schedule

Provide a valve schedule containing each valve's unique identifier, size, flow coefficient Kv (Cv), pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure to torque data, dimensions, and access and clearance requirements data. In the valve schedule include actuator selection data supported by calculations of the force required to move and seal the valve, access and clearance requirements. Provide a single valve schedule for the entire project.

3.2.5 Damper Schedule

Provide a damper schedule containing each damper's unique identifier, type (opposed or parallel blade), nominal and actual sizes, orientation of axis and frame, direction of blade rotation, actuator size and spring ranges, operation rate, positive positioner range, location of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. Include the AMCA

511 maximum leakage rate at the operating static-pressure differential for each damper in the Damper Schedule. Provide a single damper schedule for the entire project.

3.2.6 Project Summary Equipment Schedule

Provide a project summary equipment schedule containing the manufacturer, model number, part number and descriptive name for each control device, hardware and component provided under this specification. Provide a single project equipment schedule for the entire project.

3.2.7 Equipment Schedule

Provide system equipment schedules containing the unique identifier, manufacturer, model number, part number and descriptive name for each control device, hardware and component provided under this specification. Provide a separate equipment schedule for each HVAC system.

3.2.8 Occupancy Schedule

Provide an occupancy schedule drawing containing the same fields as the occupancy schedule Contract Drawing with Contractor updated information. Provide a single occupancy schedule for the entire project.

3.2.9 DDC Hardware Schedule

Provide a single DDC Hardware Schedule for the entire project and including following information for each device.

3.2.9.1 DDC Hardware Identifier

The Unique DDC Hardware Identifier for the device.

3.2.9.2 HVAC System

The system "name" used to identify a specific system (the name used on the system schematic drawing for that system).

3.2.9.3 BACnet Device Information

3.2.9.3.1 Device Object Identifier

The Device Object Identifier: The Object_Identifier of the Device Object

3.2.9.3.2 Network Number

The Network Number for the device.

3.2.9.3.3 MAC Address

The MAC Address for the device

3.2.9.3.4 BTL Listing

The BTL Listing of the device. If the device is listed under multiple BTL Profiles, indicate the profile that matches the use and configuration of the device as installed.

3.2.9.3.5 Proprietary Services Information

If the device uses non-standard ASHRAE 135 services as defined and permitted in Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS, indicate that the device uses non-standard services and include a description of all non-standard services used. Describe usage and content such that a device from another vendor can interoperate with the device using the non-standard service. Provide descriptions with sufficient detail to allow a device from a different manufacturer to be programmed to both read and write the non-standard service request:

a. read: interpret the data contained in the non-standard service and;

b. write: given similar data, generate the appropriate non-standard service request.

3.2.9.3.6 Alarming Information

Indicate whether the device is used for alarm generation, and which types of alarm generation the device implements: intrinsic, local algorithmic, remote algorithmic.

3.2.9.3.7 Scheduling Information

Indicate whether the device is used for scheduling.

3.2.9.3.8 Trending Information

Indicate whether the device is used for trending, and indicate if the device is used to trend local values, remote values, or both.

3.2.9.4 Niagara Station ID

The Niagara Station ID for each Niagara Framework Supervisory Gateway

3.2.10 Points Schedule

Provide a Points Schedule in tabular form for each HVAC system, with the indicated columns and with each row representing a hardware point, network point or configuration point in the system.

a. When a Points Schedule was included in the Contract Drawing package, use the same fields as the Contract Drawing with updated information in addition to the indicated fields.

b. When Point Schedules are included in the contract package, items requiring contractor verification or input have been shown in angle brackets ("<" and ">"), such as <___> for a required entry or <value> for a value requiring confirmation. Complete all items in brackets as well as any blank cells. Do not modify values which are not in brackets without approval.

Points Schedule Columns must include:

3.2.10.1 Point Name

The abbreviated name for the point using the indicated naming convention.

3.2.10.2 Description

A brief functional description of the point such as "Supply Air Temperature".

3.2.10.3 DDC Hardware Identifier

The Unique DDC Hardware Identifier shown on the DDC Hardware Schedule and used across all drawings for the DDC Hardware containing the point.

3.2.10.4 Settings

The value and units of any setpoints, configured setpoints, configuration parameters, and settings related to each point.

3.2.10.5 Range

The range of values, including units, associated with the point, including but not limited to a zone temperature setpoint adjustment range, a sensor measurement range, occupancy values for an occupancy input, or the status of a safety.

3.2.10.6 Input or Output (I/O) Type

The type of input or output signal associated with the point. Use the following abbreviations for entries in this column:

a. AI: The value comes from a hardware (physical) Analog Input

b. AO: The value is output as a hardware (physical) Analog Output

c. BI: The value comes from a hardware (physical) Binary Input

d. BO: The value is output as a hardware (physical) Binary Output

e. PULSE: The value comes from a hardware (physical) Pulse Accumulator Input

f. NET-IN: The value is provided from the network (generally from another device). Use this entry only when the value is received from another device as part of scheduling or as part of a sequence of operation, not when the value is received on the network for supervisory functions such as trending, alarming, override or display at a user interface.

g. NET-OUT: The value is provided to another controller over the network. Use this entry only when the value is transmitted to another device as part of scheduling or as part of a sequence of operation, not when the value is transmitted on the network for supervisory functions such as trending, alarming, override or display at a user interface.

3.2.10.7 Object and Property Information

The Object Type and Instance Number for the Object associated with the point. If the value of the point is not in the Present_Value Property, then also provide the Property ID for the Property containing the value of the point. Any point that is displayed at the front end or on an LDP, is trended, is used by another device on the network, or has an alarm condition must be documented here.

3.2.10.8 Niagara Station ID

The Niagara Station ID of the Niagara Framework Supervisory Gateway the point is mapped into.

3.2.10.9 Network Data Exchange Information (Gets Data From, Sends Data To)

Provide the DDC Hardware Identifier of other DDC Hardware the point is shared with.

3.2.10.10 Override Information (Object Type and Instance Number)

For each point requiring an Override and not residing in a Niagara Framework Supervisory Gateway, indicate if the Object for the point is Commandable or, if the use of a separate Object was specifically approved by the Contracting Officer, provide the Object Type and Instance Number of the Object to be used in overriding the point.

3.2.10.11 Alarm Information

For Niagara BACnet systems: Indicate the Alarm Generation Type and Notification Class Object Instance Number for each point requiring an alarm. (Note that not all alarms will have a Notification Class Object.)

3.2.10.12 Configuration Information

Indicate the means of configuration associated with each point. For points in a Niagara Framework Supervisory Gateway, indicate the point within the Niagara Framework Supervisory Gateway used to configure the value. For other points:

a. For Operator Configurable Points indicate BACnet Object and Property information (Name, Type, Identifiers) containing the configurable value. Indicate whether the property is writable always, or only when Out_Of_Service is TRUE.

b. For Configurable Points indicate the BACnet Object and Property information as for Operator Configurable points, or identification of the configurable settings from within the engineering software for the device or identification of the hardware settings on the device.

3.2.11 Riser Diagram

The Riser Diagram of the Building Control Network may be in tabular form, and must show all DDC Hardware and all Network Hardware, including network terminators. For each item, provide the unique identifier, common descriptive name, physical sequential order (previous and next device on the network), room identifier and location within room. A single riser diagram must be submitted for the entire system.

3.2.12 Control System Schematics

Provide control system schematics in the same form as the control system schematic Contract Drawing with Contractor updated information. Provide a control system schematic for each HVAC system.

3.2.13 Sequences of Operation

Provide HVAC control system sequence of operation and in the same format as the Contract Drawings. Within these drawings, refer to devices by their unique identifiers. Submit sequences of operation for each HVAC system

3.2.14 Controller, Motor Starter and Relay Wiring Diagram

Provide controller wiring diagrams as functional wiring diagrams which show the interconnection of conductors and cables to each controller and to the identified terminals of input and output devices, starters and package equipment. Show necessary jumpers and ground connections and the labels of all conductors. Identify sources of power required for control systems and for packaged equipment control systems back to the panel board circuit breaker number, controller enclosures, magnetic starter, or packaged equipment control circuit. Show each power supply and transformer not integral to a controller, starter, or packaged equipment. Show the connected volt-ampere load and the power supply volt-ampere rating. Provide wiring diagrams for each HVAC system.

3.3 CONTROLLER TUNING

Tune each controller in a manner consistent with that described in the ASHRAE FUN IP and in the manufacturer's instruction manual. Tuning must consist of adjustment of the proportional, integral, and where applicable, the derivative (PID) settings to provide stable closed-loop control. Each loop must be tuned while the system or plant is operating at a high gain (worst case) condition, where high gain can generally be defined as a low-flow or low-load condition. Upon final adjustment of the PID settings, in response to a change in controller setpoint, the controlled variable must settle out at the new setpoint with no more than two (2) oscillations above and below setpoint. Upon settling out at the new setpoint the controller output must be steady. With the exception of naturally slow processes such as zone temperature control, the controller must settle out at the new setpoint within five (5) minutes. Set the controller to its correct setpoint and record and submit the final PID configuration settings with the O&M Instructions and on the associated Points Schedule.

3.4 START-UP

3.4.1 Start-Up Test

Perform the following startup tests for each control system to ensure that the described control system components are installed and functioning per this specification.

Adjust, calibrate, measure, program, configure, set the time schedules, and otherwise perform all necessary actions to ensure that the systems function as indicated and shown in the sequence of operation and other contract documents.

3.4.1.1 Systems Check

An item-by-item check must be performed for each HVAC system

3.4.1.1.1 Step 1 - System Inspection

With the system in unoccupied mode and with fan hand-off-auto switches in the OFF position, verify that power and main air are available where required and that all output devices are in their failsafe and normal positions. Inspect each local display panel and each M&C Client to verify that all displays indicate shutdown conditions.

3.4.1.1.2 Step 2 - Calibration Accuracy Check

Perform a two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter by comparing the value from the test instrument to the network value provided by the DDC Hardware. Use digital indicating test instruments, such as digital thermometers, motor-driven psychrometers, and tachometers. Use test instruments with accuracy at least twice as accurate as the specified sensor accuracy and with calibration traceable to National Institute of Standards and Technology standards. Check one the first check point in the bottom one-third of the sensor range, and the second in the top one-third of the sensor range. Verify that the sensing element-to-DDC readout accuracies at two points are within the specified product accuracy tolerances, and if not recalibrate or replace the device and repeat the calibration check.

3.4.1.1.3 Step 3 - Actuator Range Check

With the system running, apply a signal to each actuator through the DDC Hardware controller. Verify proper operation of the actuators and positioners for all actuated devices and record the signal levels for the extreme positions of each device. Vary the signal over its full range, and verify that the actuators travel from zero stroke to full stroke within the signal range. Where applicable, verify that all sequenced actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other. For valve actuators and damper actuators, perform the actuator range check under normal system pressures.

3.4.1.2 Weather Dependent Test

Perform weather dependent test procedures in the appropriate climatic season.

3.4.2 Start-Up Testing Report

Submit 4 copies of the Start-Up Testing Report. The report may be submitted as a Technical Data Package documenting the results of the tests performed and certifying that the system is installed and functioning per this specification, and is ready for the Performance Verification Test (PVT).

3.5 PERFORMANCE VERIFICATION TEST (PVT)

3.5.1 PVT Procedures

Prepare PVT Procedures explaining step-by-step, the actions and expected results that will demonstrate that the control system performs in accordance with the sequences of operation, and other contract documents. Submit 4 copies of the PVT Procedures. The PVT Procedures may be submitted as a Technical Data Package.

3.5.1.1 Sensor Accuracy Checks

Include a one-point accuracy check of each sensor in the PVT procedures.

3.5.1.2 Endurance Test

Include a one-week endurance test as part of the PVT during which the system is operated continuously.

Use the building control system Niagara Trend Log Objects to trend all points shown as requiring a trend on the Point Schedule for the entire endurance test. If insufficient buffer capacity exists to trend the entire endurance test, upload trend logs during the course of the endurance test to ensure that no trend data is lost.

3.5.1.3 PVT Equipment List

Include in the PVT procedures a control system performance verification test equipment list that lists the equipment to be used during performance verification testing. For each piece of equipment, include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration

3.5.2 PVT Execution

Demonstrate compliance of the control system with the contract documents. Using test plans and procedures approved by the Government, software capable of reading and writing COV Notification Subscriptions, Notification Class Recipient List Properties, event enrollments, demonstrate all physical and functional requirements of the project. Show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. Do not start the performance verification test until after receipt of written permission by the Government, based on Government approval of the PVT Plan and Draft As-Builts and completion of balancing. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. Do not conduct tests during scheduled seasonal off periods of base heating and cooling systems. If the system experiences any failures during the endurance test portion of the PVT, repair the system repeat the endurance test portion of the PVT until the system operates continuously and without failure for the specified endurance test period.

3.5.3 PVT Report

Prepare and submit a PVT report documenting all tests performed during the PVT and their results. Include all tests in the PVT procedures and any additional tests performed during PVT. Document test failures and repairs conducted with the test results.

Submit four copies of the PVT Report. The PVT Report may be submitted as a Technical Data Package.

3.6 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

Provide HVAC control System Operation and Maintenance Instructions which include:

a. "Data Package 3" as indicated in Section 01 78 23 OPERATION AND

MAINTENANCE DATA for each piece of control equipment.

b. HVAC control system sequences of operation formatted as indicated.

c. Procedures for the HVAC system start-up, operation and shut-down including the manufacturer's supplied procedures for each piece of equipment, and procedures for the overall HVAC system.

d. As-built HVAC control system detail drawings formatted as indicated.

e. Routine maintenance checklist. Provide the routine maintenance checklist arranged in a columnar format, where the first column lists all installed devices, the second column states the maintenance activity or that no maintenance required, the third column states the frequency of the maintenance activity, and the fourth column is used for additional comments or reference.

f. Qualified service organization list, including at a minimum company name, contact name and phone number.

g. Start-Up Testing Report.

h. Performance Verification Test (PVT) Procedures and Report.

Submit 2 copies of the Operation and Maintenance Instructions, indexed and in booklet form. The Operation and Maintenance Instructions may be submitted as a Technical Data Package.

3.7 TRAINING

Conduct a training course for two operating staff members designated by the Government in the maintenance and operation of the system, including specified hardware and software. Conduct 16 hours of training at the project site within 30 days after successful completion of the performance verification test. The Government reserves the right to make audio and visual recordings (using Government supplied equipment)of the training sessions for later use. Provide audiovisual equipment and other training materials and supplies required to conduct training. A training day is defined as 8 hours of classroom instruction, including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

3.7.1 Training Documentation

Prepare training documentation consisting of:

a. Course Attendee List: Develop the list of course attendees in coordination with and signed by the Controls shop supervisor.

b. Training Manuals: Provide training manuals which include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. When presenting portions of the course material by audiovisuals, deliver copies of those audiovisuals as a part of the printed training manuals.

3.7.2 Training Course Content

For guidance in planning the required instruction, assume that attendees will have a high school education, and are familiar with HVAC systems.

During the training course, cover all of the material contained in the Operating and Maintenance Instructions, the layout and location of each controller enclosure, the layout of one of each type of equipment and the locations of each, the location of each control device external to the panels, the location of the compressed air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. Present the results of the performance verification test and the Start-Up Testing Report as benchmarks of HVAC control system performance by which to measure operation and maintenance effectiveness.

3.7.3 Training Documentation Submittal Requirements

Submit hardcopy training manuals and all training materials on CD-ROM. Provide one hardcopy manual for each trainee on the Course Attendee List and 2 additional copies for archive at the project site. Provide 2 copies of the Course Attendee List with the archival copies. Training Documentation may be submitted as a Technical Data Package.

APPENDIX A

QC CHECKLIST FOR NIAGARA FRAMEWORK BASED BACNET SYSTEMS

This checklist is not all-inclusive of the requirements of this specification and should not be interpreted as such.

Instructions: Initial each item in the space provided (|____|) verifying that the requirement has been met.

This checklist is for (circle one:)

Pre-Construction QC Checklist Submittal

Post-Construction QC Checklist Submittal

Close-out QC Checklist Submittal

Items verified for Pre-Construction, Post-Construction and Closeout QC Checklist Submittals:

1	All DDC Hardware is numbered on Control System Schematic Drawings.	|____|
2	Signal lines on Control System Schematic are labeled with the signal type.	|____|
3	Local Display Panel (LDP) Locations are shown on Control System Schematic drawings.	|____|

Items verified for Post-Construction and Closeout QC Checklist Submittals:

4	All sequences are performed as specified using DDC Hardware.	|____|
5	Training schedule and course attendee list has been developed and coordinated with shops and submitted.	|____|

Items verified for Closeout QC Checklist Submittal:

6	Final As-built Drawings, including all Points Schedule drawings, accurately represent the final installed system.	|____|
7	Programming software has been submitted for all programmable controllers.	|____|
8	All software has been licensed to the Government.	
9	O&M Instructions have been completed and submitted.	|____|
10	Training course has been completed.	|____|

QC CHECKLIST FOR NIAGARA FRAMEWORK BASED BACNET SYSTEMS			
11	All DDC Hardware is installed on a BACnet ASHRAE 135 network using either MS/TP in accordance with Clause 9 or IP in accordance with Annex J.		|____|
12	All DDC Hardware is BTL listed.		|____|
13	Communication between DDC Hardware is only via BACnet using standard services, except as specifically permitted by the specification. Non-standard services have been fully documented in the DDC Hardware Schedule.		|____|
14	Scheduling, Alarming, and Trending have been implemented using Niagara Framework objects and services, and BACnet Instrinsic Alarming as indicated.		|____|
15	All Properties indicated as required to be Writable are Writable and Overrides have been provided as indicated		|____|
	____ ___________________		
	(QC Representative Signature) (Date)		

-- End of Section --

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SECTION 23 09 13

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
11/15, CHG 2: 05/21

PART 1 GENERAL

1.1 SUMMARY

This section provides for the instrumentation control system components excluding direct digital controllers, network controllers, gateways etc. that are necessary for a completely functional automatic control system. When combined with a Direct Digital Control (DDC) system, the Instrumentation and Control Devices covered under this section must be a complete system suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as specified and indicated.

a. Install hardware to perform the control sequences as specified and indicated and to provide control of the equipment as specified and indicated.

b. Install hardware such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.

c. Install and configure hardware such that the Government or their agents are able to perform repair, replacement, and upgrades of individual hardware without further interaction with the installing Contractor.

1.1.1 Verification of Dimensions

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.1.2 Drawings

The Government will not indicate all offsets, fittings, and accessories that may be required on the drawings. Carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, arrange such work accordingly, and provide all work necessary to meet such conditions.

1.2 RELATED SECTIONS

Related work specified elsewhere.

Section 23 30 00 HVAC AIR DISTRIBUTION

Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 500-D	(2018) Laboratory Methods of Testing Dampers for Rating
AMCA 511	(2010; R 2016) Certified Ratings Program for Air Control Devices

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.15	(2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2021) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2021) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B40.100	(2022) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube

FLUID CONTROLS INSTITUTE (FCI)

FCI 70-2	(2021) Control Valve Seat Leakage

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 142	(2007; Errata 2014) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code
NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 555	(2006; Reprint Aug 2016) UL Standard for Safety Fire Dampers
UL 555S	(2014; Reprint Oct 2020) UL Standard for Safety Smoke Dampers
UL 5085-3	(2006; Reprint Jan 2022) UL Standard for Safety Low Voltage Transformers - Part 3: Class 2 and Class 3 Transformers

1.4 SUBMITTALS

Submittal requirements are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.5 DELIVERY AND STORAGE

Store and protect products from the weather, humidity, and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.

1.6 INPUT MEASUREMENT ACCURACY

Select, install and configure sensors, transmitters and DDC Hardware such that the maximum error of the measured value at the input of the DDC hardware is less than the maximum allowable error specified for the sensor or instrumentation.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 General Requirements

All products used to meet this specification must meet the indicated requirements, but not all products specified here will be required by every project. All products must meet the requirements both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section.

2.1.2 Operation Environment Requirements

Unless otherwise specified, provide products rated for continuous operation under the following conditions:

2.1.2.1 Pressure

Pressure conditions normally encountered in the installed location.

2.1.2.2 Vibration

Vibration conditions normally encountered in the installed location.

2.1.2.3 Temperature

a. Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.

b. Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of 0 to 120 degrees F and temperature conditions outside this range normally encountered at the installed location.

2.1.2.4 Humidity

10 to 95 percent relative humidity, non-condensing and also humidity conditions outside this range normally encountered at the installed location.

2.2 WEATHERSHIELDS

Provide weathershields constructed of galvanized steel painted white, unpainted aluminum, aluminum painted white, or white PVC.

2.3 TUBING

2.3.1 Copper

Provide ASTM B75/B75M or ASTM B88 rated tubing meeting the following requirements:

a. For tubing 0.375 inch outside diameter and larger provide tubing with minimum wall thickness equal to ASTM B88, Type M

b. For tubing less than 0.375 inch outside diameter provide tubing with minimum wall thickness of 0.025 inch

c. For exposed tubing and tubing for working pressures greater than 30 psig provide hard copper tubing.

d. Provide fittings which are ASME B16.18 or ASME B16.22 solder type using ASTM B32 95-5 tin-antimony solder, or which are ASME B16.26 compression type.

2.4 WIRE AND CABLE

Provide wire and cable meeting the requirements of NFPA 70 and NFPA 90A in addition to the requirements of this specification and referenced specifications.

2.4.1 Terminal Blocks

For terminal blocks which are not integral to other equipment, provide terminal blocks which are insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, suitable for DIN rail mounting, and which have enclosed sides or end plates and partition plates for separation.

2.4.2 Control Wiring for Binary Signals

For Control Wiring for Binary Signals, provide 18 AWG copper or thicker wire rated for 300-volt service.

2.4.3 Control Wiring for Analog Signals

For Control Wiring for Analog Signals, provide 18 AWG or thicker, copper, single- or multiple-twisted wire meeting the following requirements:

a. minimum 2 inch lay of twist

b. 100 percent shielded pairs

c. at least 300-volt insulation

d. each pair has a 20 AWG tinned-copper drain wire and individual overall pair insulation

e. cables have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.4.4 Power Wiring for Control Devices

For 24-volt circuits, provide insulated copper 18 AWG or thicker wire rated for 300 VAC service. For 120-volt circuits, provide 14 AWG or thicker stranded copper wire rated for 600-volt service.

2.4.5 Transformers

Provide UL 5085-3 approved transformers. Select transformers sized so that the connected load is no greater than 80 percent of the transformer rated capacity.

2.5 AUTOMATIC CONTROL VALVES

Provide valves with stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Provide valves with bodies meeting ASME B16.34 or ASME B16.15 pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure. Unless otherwise specified or indicated, provide valves meeting FCI 70-2 Class III leakage rating. Provide valves rated for modulating or two-position service as indicated, which close against a differential pressure indicated as the Close-Off pressure and which are Normally-Open, Normally-Closed, or Fail-In-Last-Position as indicated.

2.5.1 Valve Type

2.5.1.1 Liquid Service 150 Degrees F or Less

Use either globe valves or ball valves except that butterfly valves may be used for sizes 4 inch and larger.

2.5.2 Valve Flow Coefficient and Flow Characteristic

2.5.2.1 Two-Way Modulating Valves

Provide the valve coefficient (Cv) indicated. Provide equal-percentage flow characteristic for liquid service except for butterfly valves. Provide linear flow characteristic for steam service except for butterfly valves.

2.5.2.2 Three-Way Modulating Valves

Provide the valve coefficient (Cv) indicated. Provide linear flow characteristic with constant total flow throughout full plug travel.

2.5.3 Two-Position Valves

Use full line size full port valves with maximum available (Cv).

2.5.4 Globe Valves

2.5.4.1 Liquid Service Not Exceeding 150 Degrees F

a. Valve body and body connections:

   (1) valves 1-1/2 inches and smaller: brass or bronze body, with threaded or union ends

   (2) valves from 2 inches to 3 inches inclusive: brass, bronze, or iron bodies. 2 inch valves with threaded connections; 2-1/2 to 3 inches valves with flanged connections

b. Internal valve trim: Brass or bronze.

c. Stems: Stainless steel.

d. Provide valves compatible with a solution of 50 percent ethylene or propylene glycol.

2.5.5 Ball Valves

2.5.5.1 Liquid Service Not Exceeding 150 Degrees F

a. Valve body and connections:

   (1) valves 1-1/2 inches and smaller: bodies of brass or bronze, with threaded or union ends

   (2) valves from 2 inches to 3 inches inclusive: bodies of brass, bronze, or iron. 2 inch valves with threaded connections; valves from 2-1/2 to 3 inches with flanged connections.

b. Ball: Stainless steel or nickel-plated brass or chrome-plated brass.

c. Seals: Reinforced Teflon seals and EPDM O-rings.

d. Stem: Stainless steel, blow-out proof.

e. Provide valves compatible with a solution of 50 percent ethylene or propylene glycol.

2.5.6 Butterfly Valves

Provide butterfly valves which are threaded lug type suitable for dead-end service and modulation to the fully-closed position, with carbon-steel bodies or with ductile iron bodies in accordance with ASTM A536. Provide butterfly valves with non-corrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from -20 to +250 degrees F. Provide valves with rated Cv of the Cv at 70 percent (60 degrees) open position. Provide valves meeting FCI 70-2 Class VI leakage rating.

2.5.7 Pressure Independent Control Valves (PICV)

Provide pressure independent control valves which include a regulator valve which maintains the differential pressure across a flow control valve. Pressure independent control valves must accurately control the flow from 0-100 percent full rated flow regardless of changes in the piping pressure and not vary the flow more than plus or minus 5 percent at any given flow control valve position when the PICV differential pressure lies between the manufacturer's stated minimum and maximum. The rated minimum differential pressure for steady flow must not exceed 5 psid across the PICV. Provide either globe or ball type valves meeting the indicated requirements for globe and ball valves. Provide valves with a flow tag listing full rated flow and minimum required pressure drop. Provide valves with factory installed Pressure/Temperature ports ("Pete's Plugs") to measure the pressure drop to determine the valve flow rate.

2.6 DAMPERS

2.6.1 Damper Assembly

Provide single damper sections with blades no longer than 48 inches and which are no higher than 72 inches and damper blade width of 8 inches or less. When larger sizes are required, combine damper sections. Provide dampers made of steel, or other materials where indicated and with assembly frames constructed of 0.07 inch minimum thickness galvanized steel channels with mitered and welded corners. Steel channel frames constructed of 0.06 inch minimum thickness are acceptable provided the corners are reinforced.

a. Flat blades must be made rigid by folding the edges. Blade-operating linkages must be within the frame so that blade-connecting devices within the same damper section must not be located directly in the air stream.

b. Damper axles must be 1/2 inch minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically must be supported by thrust bearings.

c. Provide dampers which do not exceed a pressure drop through the damper of 0.04 inches water gauge at 1000 ft/min in the wide-open position. Provide dampers with frames not less than 2 inch in width. Provide dampers which have been tested in accordance with AMCA 500-D.

2.6.2 Operating Linkages

For operating links external to dampers, such as crank arms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, provide links able to withstand a load equal to at least 300 percent of the maximum required damper-operating force without deforming. Rod lengths must be adjustable. Links must be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises must be brass, bronze, or stainless steel. Adjustments of crank arms must control the open and closed positions of dampers.

2.6.3 Damper Types

2.6.3.1 Flow Control Dampers

Provide parallel-blade or opposed blade type dampers for outside air, return air, relief air, exhaust, face and bypass dampers as indicated on the Damper Schedule. Blades must have interlocking edges. The channel frames of the dampers must be provided with jamb seals to minimize air leakage. Unless otherwise indicated, dampers must meet AMCA 511 Class 1A requirements. Outside air damper seals must be suitable for an operating temperature range of -40 to +167 degrees F. Dampers must be rated at not less than 2000 ft/min air velocity.

2.6.3.2 Mechanical Rooms and Other Utility Space Ventilation Dampers

Provide utility space ventilation dampers as indicated. Unless otherwise indicated provide AMCA 511 class 3 dampers. Provide dampers rated at not less than 1500 ft/min air velocity.

2.6.3.3 Smoke Dampers

Provide smoke-damper and actuator assemblies which meet the current requirements of NFPA 90A, UL 555, and UL 555S. For combination fire and smoke dampers provide dampers rated for 250 degrees F Class II leakage per UL 555S.

2.7 SENSORS AND INSTRUMENTATION

Unless otherwise specified, provide sensors and instrumentation which incorporate an integral transmitter. Sensors and instrumentation, including their transmitters, must meet the specified accuracy and drift requirements at the input of the connected DDC Hardware's analog-to-digital conversion.

2.7.1 Analog and Binary Transmitters

Provide transmitters which match the characteristics of the sensor. Transmitters providing analog values must produce a linear 4-20 mAdc, 0-10 Vdc signal corresponding to the required operating range and must have zero and span adjustment. Transmitters providing binary values must have dry contacts rated at 1A at 24 Volts AC.

2.7.2 Network Transmitters

Sensors and Instrumentation incorporating an integral network connection are considered DDC Hardware and must meet the DDC Hardware requirements of 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS when used in a BACnet network.

2.7.3 Temperature Sensors

Provide the same sensor type throughout the project. Temperature sensors may be provided without transmitters. Where transmitters are used, the range must be the smallest available from the manufacturer and suitable for the application such that the range encompasses the expected range of temperatures to be measured. The end to end accuracy includes the combined effect of sensitivity, hysteresis, linearity and repeatability between the measured variable and the end user interface (graphic presentation) including transmitters if used.

2.7.3.1 Sensor Accuracy and Stability of Control

2.7.3.1.1 Conditioned Space Temperature

Plus or minus 0.5 degree F over the operating range.

2.7.3.1.2 Unconditioned Space Temperature

a. Plus or minus 1 degree F over the range of 30 to 131 degrees F AND

b. Plus or minus 4 degrees F over the rest of the operating range.

2.7.3.1.3 Duct Temperature

Plus or minus 0.5 degree F

2.7.3.1.4 Outside Air Temperature

a. Plus or minus 2 degrees F over the range of -30 to +130 degrees F AND

b. Plus or minus 1 degree F over the range of 30 to 130 degrees F.

2.7.3.1.5 High Temperature Hot Water

Plus or minus 3.6 degrees F.

2.7.3.1.6 Chilled Water

Plus or minus 0.8 degrees F over the range of 35 to 65 degrees F.

2.7.3.2 Transmitter Drift

The maximum allowable transmitter drift: 0.25 degrees F per year.

2.7.3.3 Point Temperature Sensors

Point Sensors must be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper.

2.7.3.4 Temperature Sensor Details

2.7.3.4.1 Room Type

Provide the sensing element components within a decorative protective cover suitable for surrounding decor.

2.7.3.4.2 Duct Probe Type

Ensure the probe is long enough to properly sense the air stream temperature.

2.7.3.4.3 Duct Averaging Type

Continuous averaging sensors must be one foot in length for each 1 square foot of duct cross-sectional area, and a minimum length of 5 feet.

2.7.3.4.4 Pipe Immersion Type

For pipes with larger than 3 inch diameter, provide minimum 3 inch immersion. For pipes with less than 3 inch diameter, provide immersion at least half the diameter of the pipe. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells must be stainless steel when used in steel piping, and brass when used in copper piping.

2.7.3.4.5 Outside Air Type

Provide the sensing element rated for outdoor use

2.7.4 Relative Humidity Sensor

Relative humidity sensors must use bulk polymer resistive or thin film capacitive type non-saturating sensing elements capable of withstanding a saturated condition without permanently affecting calibration or sustaining damage. The sensors must include removable protective membrane filters. Where required for exterior installation, sensors must be capable of surviving below freezing temperatures and direct contact with moisture without affecting sensor calibration. When used indoors, the sensor must be capable of being exposed to a condensing air stream (100 percent relative humidity) with no adverse effect to the sensor's calibration or other harm to the instrument. The sensor must be of the wall-mounted or duct-mounted type, as required by the application, and must be provided with any required accessories. Sensors used in duct high-limit applications must have a bulk polymer resistive sensing element. Duct-mounted sensors must be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. Relative humidity (RH) sensors must measure relative humidity over a range of 0 percent to 100 percent with an accuracy of plus or minus 2 percent. RH sensors must function over a temperature range of 40 to 135 degrees F and must not drift more than 1 percent per year.

2.7.5 Carbon Dioxide (CO2) Sensors

Provide photometric type CO2 sensors with integral transducers and linear output. Carbon dioxide (CO2) sensors must measure CO2 concentrations between 0 to 2000 parts per million (ppm) using non-dispersible infrared (NDIR) technology with an accuracy of plus or minus 50 ppm and a maximum response time of 1 minute. The sensor must be rated for operation at ambient air temperatures within the range of 32 to 122 degrees F and relative humidity within the range of 20 to 95 percent (non-condensing). The sensor must have a maximum drift of 2 percent per year. The sensor chamber must be manufactured with a non-corrosive material that does not affect carbon dioxide sample concentration. Duct mounted sensors must be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. The sensor must have a calibration interval no less than 5 years.

2.7.6 Differential Pressure Instrumentation

2.7.6.1 Differential Pressure Sensors

Provide Differential Pressure Sensors with ranges as indicated or as required for the application. Pressure sensor ranges must not exceed the high end range indicated on the Points Schedule by more than 50 percent. The over pressure rating must be a minimum of 150 percent of the highest design pressure of either input to the sensor. The accuracy must be plus or minus 1 percent of full scale. The sensor must have a maximum drift of 2 percent per year

2.7.6.2 Differential Pressure Switch

Provide differential pressure switches with a user-adjustable setpoint which are sized for the application such that the setpoint is between 25 percent and 75 percent of the full range. The over pressure rating must be a minimum of 150 percent of the highest design pressure of either input to the sensor. The switch must have two sets of contacts and each contact must have a rating greater than it's connected load. Contacts must open or close upon rise of pressure above the setpoint or drop of pressure below the setpoint as indicated.

2.7.7 Flow Sensors

2.7.7.1 Airflow Measurement Array (AFMA)

2.7.7.1.1 Airflow Straightener

Provide AFMAs which contain an airflow straightener if required by the AFMA manufacturer's published installation instructions. The straightener must be contained inside a flanged sheet metal casing, with the AFMA located as specified according to the published recommendation of the AFMA manufacturer. In the absence of published documentation, provide airflow straighteners if there is any duct obstruction within 5 duct diameters upstream of the AFMA. Air-flow straighteners, where required, must be constructed of 0.125 inch aluminum honeycomb and the depth of the straightener must not be less than 1.5 inches.

2.7.7.1.2 Resistance to Airflow

The resistance to air flow through the AFMA, including the airflow straightener must not exceed 0.085 inch water gauge at an airflow of 2,000 fpm. AFMA construction must be suitable for operation at airflows of up to 5000 fpm over a temperature range of 40 to 120 degrees F.

2.7.7.1.3 Outside Air Temperature

In outside air measurement or in low-temperature air delivery applications, provide an AFMA certified by the manufacturer to be accurate as specified over a temperature range of -20 to +120 degrees F .

2.7.7.1.4 Pitot Tube AFMA

Each Pitot Tube AFMA must contain an array of velocity sensing elements. The velocity sensing elements must be of the multiple pitot tube type with averaging manifolds. The sensing elements must be distributed across the duct cross section in the quantity and pattern specified or recommended by the published installation instructions of the AFMA manufacturer.

a. Pitot Tube AFMAs for use in airflows over 600 fpm must have an accuracy of plus or minus 5 percent over a range of 500 to 2500 fpm.

b. Pitot Tube AFMAs for use in airflows under 600 fpm must have an accuracy of plus or minus 5 percent over a range of 125 to 2500 fpm.

2.7.7.1.5 Electronic AFMA

Each electronic AFMA must consist of an array of velocity sensing elements of the resistance temperature detector (RTD) or thermistor type. The sensing elements must be distributed across the duct cross section in the quantity and pattern specified or recommended by the published application data of the AFMA manufacturer. Electronic AFMAs must have an accuracy of plus or minus 5 percent over a range of 125 to 5,000 fpm and the output must be temperature compensated over a range of 32 to 212 degrees F.

2.7.7.1.6 Fan Inlet Measurement Devices

Fan inlet measurement devices cannot be used unless indicated on the drawings or schedules.

2.7.7.2 Orifice Plate

Orifice plate must be made of an austenitic stainless steel sheet of 0.125 inch nominal thickness with an accuracy of plus or minus 1 percent of full flow. The orifice plate must be flat within 0.002 inches. The orifice surface roughness must not exceed 20 micro-inches. The thickness of the cylindrical face of the orifice must not exceed 2 percent of the pipe inside diameter or 12.5 percent of the orifice diameter, whichever is smaller. The upstream edge of the orifice must be square and sharp. Where orifice plates are used, concentric orifice plates must be used in all applications except steam flow measurement in horizontal pipelines.

2.7.7.3 Flow Nozzle

Flow nozzle must be made of austenitic stainless steel with an accuracy of plus or minus 1 percent of full flow. The inlet nozzle form must be elliptical and the nozzle throat must be the quadrant of an ellipse. The thickness of the nozzle wall and flange must be such that distortion of the nozzle throat from strains caused by the pipeline temperature and pressure, flange bolting, or other methods of installing the nozzle in the pipeline must not cause the accuracy to degrade beyond the specified limit. The outside diameter of the nozzle flange or the design of the flange facing must be such that the nozzle throat must be centered accurately in the pipe.

2.7.7.4 Venturi Tube

Venturi tube must be made of cast iron or cast steel and must have an accuracy of plus or minus 1 percent of full flow. The throat section must be lined with austenitic stainless steel. Thermal expansion characteristics of the lining must be the same as that of the throat casting material. The surface of the throat lining must be machined to a plus or minus 50 micro inch finish, including the short curvature leading from the converging entrance section into the throat.

2.7.7.5 Annular Pitot Tube

Annular pitot tube must be made of austenitic stainless steel with an accuracy of plus or minus 2 percent of full flow and a repeatability of plus or minus 0.5 percent of measured value. The unit must have at least one static port and no less than four total head pressure ports with an averaging manifold.

2.7.7.6 Insertion Turbine Flowmeter

Provide dual axial turbine flowmeter with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. All parts must meet or exceed the pressure classification of the pipe system it is installed in. Insertion Turbine Flowmeter accuracy must be plus or minus 0.5 percent of rate at calibrated velocity., within plus or minus of rate over a 10:1 turndown and within plus or minus 2 percent of rate over a 50:1 turndown. Repeatability must be plus or minus 0.25 percent of reading. The meter flow sensing element must operate over a range suitable for the installed location with a pressure loss limited to 1 percent of operating pressure at maximum flow rate. The flowmeter ,must include either dry contact pulse outputs, 4-20mA, 0-10Vdc or 0-5Vdc outputs. The turbine rotor assembly must be constructed of Series 300 stainless steel and use Teflon seals.

2.7.7.7 Vortex Shedding Flowmeter

Vortex Shedding Flowmeter accuracy must be within plus or minus 0.8 percent of the actual reading over the range of the meter. Steam meters must contain density compensation by direct measurement of temperature. Mass flow inferred from specified steam pressure are not acceptable. The flow meter body must be made of austenitic stainless steel and include a weather tight NEMA 4X electronics enclosure. The vortex shedding flowmeter body must not require removal from the piping in order to replace the shedding sensor.

2.7.7.8 Ultrasonic Flow Meter

Provide Ultrasonic Flow Meters complete with matched transducers, self aligning installation hardware and transducer cables. Ultrasonic transducers must be optimized for the specific pipe and process conditions for the application. The flow meter accuracy must plus or minus 1 percent of rate from 0 to 40 ft/sec. The flowmeter must include either dry contact pulse outputs, 4-20mA, 0-10Vdc or 0-5Vdc output.

2.7.7.9 Insertion Magnetic Flow Meter

Provide insertion type magnetic flowmeters with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. All parts must meet or exceed the pressure classification of the pipe system it is installed in. Flowmeter accuracy must be no greater than plus or minus 1 percent of rate from 2 to 20 feet/sec. Wetted material parts must be 300 series stainless steel. The flowmeter must include either dry contact pulse outputs, 4-20mA, 0-10Vdc or 0-5Vdc outputs.

2.7.7.10 Positive Displacement Flow Meter

The flow meter must be a direct reading, gerotor, nutating disc or vane type displacement device rated for liquid service as indicated. A counter must be mounted on top of the meter, and must consist of a non-resettable mechanical totalizer for local reading, and a pulse transmitter for remote reading. The totalizer must have a six digit register to indicate the volume passed through the meter in gallons, and a sweep-hand dial to indicate down to 0.25 gallons. The pulse transmitter must have a hermetically sealed reed switch which is activated by magnets fixed on gears of the counter. The meter must have a bronze body with threaded or flanged connections as required for the application. Output accuracy must be plus or minus 2 percent of the flow range. The maximum pressure drop at full flow must be 5 psig.

2.7.7.11 Flow Meters, Paddle Type

Sensor must be non-magnetic, with forward curved impeller blades designed for water containing debris. Sensor accuracy must be plus or minus 1 percent of rate of flow, minimum operating flow velocity must be 1 foot per second. Sensor repeatability and linearity must be plus or minus 1 percent. Materials which will be wetted must be made from non-corrosive materials and must not contaminate water. The sensor must be rated for installation in pipes of 3 to 40 inch diameters. The transmitter housing must be a NEMA 250 Type 4 enclosure.

2.7.7.12 Flow Switch

Flow switch must have a repetitive accuracy of plus or minus 10 percent of actual flow setting. Switch actuation must be adjustable over the operating flow range, and must be sized for the application such that the setpoint is between 25 percent and 75 percent of the full range.. The switch must have Form C snap-action contacts, rated for the application. The flow switch must have non flexible paddle with magnetically actuated contacts and be rated for service at a pressure greater than the installed conditions. Flow switch for use in sewage system must be rated for use in corrosive environments encountered.

2.7.7.13 Gas Flow Meter

Gas flow meter must be diaphragm or bellows type (gas positive displacement meters) for flows up to 2500 SCFH and axial flow turbine type for flows above 2500 SCFH, designed specifically for natural gas supply metering, and rated for the pressure, temperature, and flow rates of the installation. Meter must have a minimum turndown ratio of 10 to 1 with an accuracy of plus or minus 1 percent of actual flow rate. The meter index must include a direct reading mechanical totalizing register and electrical impulse dry contact output for remote monitoring. The electrical impulse dry contact output must not require field adjustment or calibration. The electrical impulse dry contact output must have a minimum resolution of 100 cubic feet of gas per pulse and must not exceed 15 pulses per second at the design flow.

2.7.8 Electrical Instruments

Provide Electrical Instruments with an input range as indicated or sized for the application. Unless otherwise specified, AC instrumentation must be suitable for 60 Hz operation.

2.7.8.1 Current Transducers

Current transducers must accept an AC current input and must have an accuracy of plus or minus 2 percent of full scale. The device must have a means for calibration. Current transducers for variable frequency applications must be rated for variable frequency operation.

2.7.8.2 Current Sensing Relays (CSRs)

Current sensing relays (CSRs) must provide a normally-open contact with a voltage and amperage rating greater than its connected load. Current sensing relays must be of split-core design. The CSR must be rated for operation at 200 percent of the connected load. Voltage isolation must be a minimum of 600 volts. The CSR must auto-calibrate to the connected load or be adjustable and field calibrated. Current sensors for variable frequency applications must be rated for variable frequency operation.

2.7.8.3 Voltage Transducers

Voltage transducers must accept an AC voltage input and have an accuracy of plus or minus 0.25 percent of full scale. The device must have a means for calibration. Line side fuses for transducer protection must be provided.

2.7.9 Carbon Monoxide Analyzer

Carbon monoxide analyzer must consist of an infrared light source in a weather proof steel enclosure for duct or stack mounting. An optical detector/analyzer in a similar enclosure, suitable for duct or stack mounting must be provided. Both assemblies must include internal blower systems to keep optical windows free of dust and ash at all times. The third component of the analyzer must be the electronics cabinet. Automatic flue gas temperature compensation and manual/automatic zeroing devices must be provided. Unit must read parts per million (ppm) of carbon monoxide in the range of 100 to 10,000 ppm and the response time must be less than 3 seconds to 90 percent value. Unit measurement range must not exceed specified range by more that 50 percent. Repeatability must be plus or minus 1 percent of full scale with an accuracy of plus or minus 1 percent of full scale.

2.7.10 Vibration Switch

Vibration switch must be solid state, enclosed in a NEMA 250 Type 4 or Type 4X housing with sealed wire entry. Unit must have two independent sets of Form C switch contacts with one set to shutdown equipment upon excessive vibration and a second set for monitoring alarm level vibration. The vibration sensing range must be a true rms reading, suitable for the application. The unit must include either displacement response for low speed or velocity response for high speed application. The frequency range must be at least 3 Hz to 500 Hz. Contact time delay must be 3 seconds. The unit must have independent start-up and running delay on each switch contact. Alarm limits must be adjustable and setpoint accuracy must be plus or minus 10 percent of setting with repeatability of plus or minus 2 percent.

2.7.11 Conductivity Sensor

Sensor must include local indicating meter and must be suitable for measurement of conductivity of water in boilers, chilled water systems, condenser water systems, distillation systems, or potable water systems as indicated. Sensor must sense from 0 to 10 microSeimens per centimeter (μS/cm) for distillation systems, 0 to 100 μS/cm for boiler, chilled water, and potable water systems and 0 to 1000 μS/cm for condenser water systems. Contractor must field verify the ranges for particular applications and adjust the range as required. The output must be temperature compensated over a range of 32 to 212 degrees F. The accuracy must be plus or minus 2 percent of the full scale reading. Sensor must have automatic zeroing and must require no periodic maintenance or recalibration.

2.7.12 Turbidity Sensor

Sensor must include a local indicating meter and must be suitable for measurement of turbidity of water. Sensor must sense from 0 to 1000 Nephelometric Turbidity Units (NTU). Range must be field-verified for the particular application and adjusted as required. The output must be temperature compensated over a range of 32 to 212 degrees F. The accuracy must be plus or minus 5 percent of full scale reading. Sensor must have automatic zeroing and must not require periodic maintenance or recalibration.

2.7.13 Chlorine Detector

The detector must measure concentrations of chlorine in water in the range 0 to 20 ppm with a repeatability of plus or minus 1 percent of full scale and an accuracy of plus or minus 2 percent of full scale. The Chlorine Detector transmitter must be housed in a non-corrosive NEMA 250 Type 4X enclosure. Detector must include a local panel with adjustable alarm trip level, local audio and visual alarm with silence function.

2.7.14 Floor Mounted Leak Detector

Leak detectors must use electrodes mounted at slab level with a minimum built-in-vertical adjustment of 0.125 inches. Detector must have a binary output. The indicator must be manual reset type.

2.7.15 Temperature Switch

2.7.15.1 Duct Mount Temperature Low Limit Safety Switch (Freezestat)

Duct mount temperature low limit switches (Freezestats) must be manual reset, low temperature safety switches at least 1 foot long per square foot of coverage which must respond to the coldest 18 inch segment with an accuracy of plus or minus 3.6 degrees F. The switch must have a field-adjustable setpoint with a range of at least 30 to 50 degrees F. The switch must have two sets of contacts, and each contact must have a rating greater than its connected load. Contacts must open or close upon drop of temperature below setpoint as indicated and must remain in this state until reset.

2.7.15.2 Pipe Mount Temperature Limit Switch (Aquastat)

Pipe mount temperature limit switches (aquastats) must have a field adjustable setpoint between 60 and 90 degrees F, an accuracy of plus or minus 3.6 degrees F and a 10 degrees F fixed deadband. The switch must have two sets of contacts, and each contact must have a rating greater than its connected load. Contacts must open or close upon change of temperature above or below setpoint as indicated.

2.7.16 Damper End Switches

Each end switch must be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure must be suitable for mounting on the duct exterior and must permit setting the position of the trip lever that actuates the switch. The trip lever must be aligned with the damper blade.

End switches integral to an electric damper actuator are allowed as long as at least one is adjustable over the travel of the actuator.

2.7.17 Air Quality Sensors

Provide full spectrum air quality sensors using a hot wire element based on the Taguchi principle. The sensor must monitor a wide range of gaseous volatile organic components common in indoor air contaminants like paint fumes, solvents, cigarette smoke, and vehicle exhaust. The sensor must automatically compensate for temperature and humidity, have span and calibration potentiometers, operate on 24 VDC power with output of 0-10 VDC, and have a service rating of 32 to 140 degrees F and 5 to 95 percent relative humidity.

2.8 INDICATING DEVICES

All indicating devices must display readings in English (inch-pound) units.

2.8.1 Thermometers

Provide bi-metal type thermometers at locations indicated. Thermometers must have either 9 inch long scales or 3.5 inch diameter dials, with insertion, immersion, or averaging elements. Provide matching thermowells for pipe-mounted installations. Select scale ranges suitable for the intended service, with the normal operating temperature near the scale's midpoint. The thermometer's accuracy must be plus or minus 2 percent of the scale range.

2.8.1.1 Piping System Thermometers

Piping system thermometers must have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale. Piping system thermometers must have an accuracy of plus or minus 1 percent of scale range. Thermometers for piping systems must have rigid stems with straight, angular, or inclined pattern. Thermometer stems must have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem must be filled with a heat-transfer medium.

2.8.1.2 Air-Duct Thermometers

Air-duct thermometers must have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism.

2.8.2 Pressure Gauges

Provide pipe-mounted pressure gauges at the locations indicated. Gauges must conform to ASME B40.100 and have a 4 inch diameter dial and shutoff cock. Select scale ranges suitable for the intended service, with the normal operating pressure near the scale's midpoint. The gauge's accuracy must be plus or minus 2 percent of the scale range.

Gauges must be suitable for field or panel mounting as required, must have black legend on white background, and must have a pointer traveling through a 270-degree arc. Gauge range must be suitable for the application with an upper end of the range not to exceed 150 percent of the design upper limit. Accuracy must be plus or minus 3 percent of scale range. Gauges must meet requirements of ASME B40.100.

2.8.3 Low Differential Pressure Gauges

Gauges for low differential pressure measurements must be a minimum of 3.5 inch (nominal) size with two sets of pressure taps, and must have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauge range must be suitable for the application with an upper end of the range not to exceed 150 percent of the design upper limit. Accuracy must be plus or minus two percent of scale range.

2.9 OUTPUT DEVICES

2.9.1 Actuators

Actuators must be electric (electronic) . All actuators must be normally open (NO), normally closed (NC) or fail-in-last-position (FILP) as indicated. Normally open and normally closed actuators must be of mechanical spring return type. Electric actuators must have an electronic cut off or other means to provide burnout protection if stalled. Actuators must have a visible position indicator. Electric actuators must provide position feedback to the controller as indicated. Actuators must smoothly and fully open or close the devices to which they are applied. Electric actuators must have a full stroke response time in both directions of 90 seconds or less at rated load. Electric actuators must be of the foot-mounted type with an oil-immersed gear train or the direct-coupled type. Where multiple electric actuators operate from a common signal, the actuators must provide an output signal identical to its input signal to the additional devices. All actuators must be rated for their operating environment. Actuators used outdoors must be designed and rated for outdoor use. Actuators under continuous exposure to water, such as those used in sumps, must be submersible.

Actuators incorporating an integral network connection are considered DDC Hardware and must meet the DDC Hardware requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

2.9.1.1 Valve Actuators

Valve actuators must provide shutoff pressures and torques as indicated on the Valve Schedule.

2.9.1.2 Damper Actuators

Damper actuators must provide the torque necessary per damper manufacturer's instructions to modulate the dampers smoothly over its full range of operation and torque must be at least 6 inch-pounds/1 square foot of damper area for opposed blade dampers and 9 inch-pounds/1 square foot of damper area for parallel blade dampers.

2.9.1.3 Electric Actuators

Each actuator must have distinct markings indicating the full-open and full-closed position Each actuator must deliver the torque required for continuous uniform motion and must have internal end switches to limit the travel, or be capable of withstanding continuous stalling without damage. Actuators must function properly within 85 to 110 percent of rated line voltage. Provide actuators with hardened steel running shafts and gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torques less than 16 inch-pounds..

a. Two-position actuators must be single direction, spring return, or reversing type. Two position actuator signals may either be the control power voltage or line voltage as needed for torque or appropriate interlock circuits.

b. Modulating actuators must be capable of stopping at any point in the cycle, and starting in either direction from any point. Actuators must be equipped with a switch for reversing direction, and a button to disengage the clutch to allow manual adjustments. Provide the actuator with a hand crank for manual adjustments, as applicable. Modulating actuator input signals can either be a 4 to 20 mAdc or a 0-10 VDC signal.

c. Floating or pulse width modulation actuators are acceptable for non-fail safe applications unless indicated otherwise provided that the floating point control (timed actuation) must have a scheduled re-calibration of span and position no more than once a day and no less than once a week. The schedule for the re-calibration should not affect occupied conditions and be staggered between equipment to prevent falsely loading or unloading central plant equipment.

2.9.2 Solenoid-Operated Electric to Pneumatic Switch (EPS)

Solenoid-Operated Electric to Pneumatic Switches (EPS) must accept a voltage input to actuate its air valve. Each valve must have three-port operation: common, normally open, and normally closed. Each valve must have an outer cast aluminum body and internal parts of brass, bronze, or stainless steel. The air connection must be a 0.38 inch NPT threaded connection. Valves must be rated for 50 psig.

2.9.3 Electric to Pneumatic Transducers (EP)

Electric to Pneumatic Transducers (EPs) must convert either a 4-20 mAdc input signal, a 0-10 Vdc input signal to a proportional 0 to 20 psig pneumatic output. The EP must withstand pressures at least 150 percent of the system supply air pressure (main air). EPs must include independent offset and span adjustment. Steady state air consumption must not be greater than 0.05 scfm. EPs must have a manual adjustable override for the EP pneumatic output. EPs must have sufficient output capacity to provide full range stroke of the actuated device in both directions within 90 seconds.

2.9.4 Relays

Relays must have contacts rated for the intended application, indicator light, and dust proof enclosure. The indicator light must be lit when the coil is energized and off when coil is not energized.

Control relay contacts must have utilization category and ratings selected for the application. Each set of contacts must incorporate a normally open (NO), normally closed (NC) and common contact. Relays must be rated for a minimum life of one million operations.

2.10 USER INPUT DEVICES

User Input Devices, including potentiometers, switches and momentary contact push-buttons. Potentiometers must be of the thumb wheel or sliding bar type. Momentary Contact Push-Buttons may include an adjustable timer for their output. User input devices must be labeled for their function.

2.11 MULTIFUNCTION DEVICES

Multifunction devices are products which combine the functions of multiple sensor, user input or output devices into a single product. Unless otherwise specified, the multifunction device must meet all requirements of each component device. Where the requirements for the component devices conflict, the multifunction device must meet the most stringent of the requirements.

2.11.1 Current Sensing Relay Command Switch

The Current Sensing Relay portion must meet all requirements of the Current Sensing Relay input device. The Command Switch portion must meet all requirements of the Relay output device except that it must have at least one normally-open (NO) contact.

Current Sensing Relays used for Variable Frequency Drives must be rated for Variable Frequency applications unless installed on the source side of the drive. If used in this situation, the threshold for showing status must be set to allow for the VFD's control power when the drive is not enabled and provide indication of operation when the drive is enabled at minimum speed.

2.11.2 Space Sensor Module

Space Sensor Modules must be multifunction devices incorporating a temperature sensor and one or more of the following as specified and indicated on the Space Sensor Module Schedule:

a. A temperature indicating device.

b. A User Input Device which must adjust a temperature setpoint output.

c. A User Input Momentary Contact Button and an output to the control system indicating zone occupancy.

d. A three position User Input Switch labeled to indicate heating, cooling and off positions ('HEAT-COOL-OFF' switch) and providing corresponding outputs to the control system.

e. A two position User Input Switch labeled with 'AUTO' and 'ON' positions and providing corresponding output to the control system..

f. A multi-position User Input Switch with 'OFF' and at least two fan speed positions and providing corresponding outputs to the control system.

Space Sensor Modules cannot contain mercury (Hg).

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General Installation Requirements

Perform the installation under the supervision of competent technicians regularly employed in the installation of DDC systems.

3.1.1.1 Device Mounting Criteria

All devices must be installed in accordance with manufacturer's recommendations and as specified and indicated. Control devices to be installed in piping and ductwork must be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements must not be used except as specified. Spare thermowells must be installed adjacent to each thermowell containing a sensor and as indicated. Devices located outdoors must have a weathershield.

3.1.1.2 Labels and Tags

Match labels and tags to the unique identifiers indicated on the As-Built drawings. Label all enclosures and instrumentation. Tag all sensors and actuators in mechanical rooms. Tag airflow measurement arrays to show flow rate range for signal output range, duct size, and pitot tube AFMA flow coefficient. Tag duct static pressure taps at the location of the pressure tap. Provide plastic or metal tags, mechanically attached directly to each device or attached by a metal chain or wire. Labels exterior to protective enclosures must be engraved plastic and mechanically attached to the enclosure or instrumentation. Labels inside protective enclosures may attached using adhesive, but must not be hand written.

3.1.2 Weathershield

Provide weathershields for sensors located outdoors. Install weathershields such that they prevent the sun from directly striking the sensor and prevent rain from directly striking or dripping onto the sensor. Install weather shields with adequate ventilation so that the sensing element responds to the ambient conditions of the surroundings. When installing weathershields near outside air intake ducts, install them such that normal outside air flow does not cause rainwater to strike the sensor.

3.1.3 Room Instrument Mounting

Mount room instruments, including but not limited to wall mounted non-adjustable space sensor modules and sensors located in occupied spaces, 48 inches above the floor unless otherwise indicated. Install adjustable devices to be ADA compliant unless otherwise indicated on the Room Sensor Schedule:

a. Space Sensor Modules for Fan Coil Units may be either unit or wall mounted but not mounted on an exterior wall.

b. Wall mount all other Space Sensor Modules.

3.1.4 Indication Devices Installed in Piping and Liquid Systems

Provide snubbers for gauges in piping systems subject to pulsation. For gauges for steam service use pigtail fittings with cock. Install thermometers and temperature sensing elements in liquid systems in thermowells. Provide spare Pressure/Temperature Ports (Pete's Plug) for all temperature and pressure sensing elements installed in liquid systems for calibration/testing.

3.1.5 Occupancy Sensors

Provide a sufficient quantity of occupancy sensors to provide complete coverage of the area (room or space). Occupancy sensors are to be ceiling mounted. Install occupancy sensors in accordance with NFPA 70 requirements and the manufacturer's instructions. Do not locate occupancy sensors within 6 feet of HVAC outlets or heating ducts, or where they can "see" beyond any doorway. Installation above doorway(s) is preferred. Do not use ultrasonic sensors in spaces containing ceiling fans. Install sensors to detect motion to within 2 feet of all room entrances and to not trigger due to motion outside the room. Set the off-delay timer to 15 minutes unless otherwise indicated. Adjust sensors prior to beneficial occupancy, but after installation of furniture systems, shelving, partitions, etc. For each controlled area, provide one hundred percent coverage capable of detecting small hand-motion movements, accommodating all occupancy habits of single or multiple occupants at any location within the controlled room.

3.1.6 Switches

3.1.6.1 Temperature Limit Switch

Provide a temperature limit switch (freezestat) to sense the temperature at the location indicated. Provide a sufficient number of temperature limit switches (freezestats) to provide complete coverage of the duct section but no less than 1 foot in length per square foot of cross sectional area. Install manual reset limit switches in approved, accessible locations where they can be reset easily. Install temperature limit switch (freezestat) sensing elements in a side-to-side (not top-to-bottom) serpentine pattern with the relay section at the highest point and in accordance with the manufacturer's installation instructions.

3.1.6.2 Hand-Off Auto Switches

Wire safety controls such as smoke detectors and freeze protection thermostats to protect the equipment during both hand and auto operation.

3.1.7 Temperature Sensors

Install temperature sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate and install sensors according to manufacturer’s instructions. Select sensors only for intended application as designated or recommended by manufacturer.

3.1.7.1 Room Temperature Sensors

Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of all user-adjustable sensors at the heights indicated. Non user-adjustable sensors can be mounted as indicated in paragraph ROOM INSTRUMENT MOUNTING.

3.1.7.2 Duct Temperature Sensors

3.1.7.2.1 Probe Type

Place tip of the sensor in the middle of the airstream or in accordance with manufacturer's recommendations or instructions.Provide a gasket between the sensor housing and the duct wall. Seal the duct penetration air tight. When installed in insulated duct, provide enclosure or stand off fitting to accommodate the thickness of duct insulation to allow for maintenance or replacement of the sensor and wiring terminations. Seal the duct insulation penetration vapor tight.

3.1.7.2.2 Averaging Type

Weave the sensing element in a serpentine fashion from side to side perpendicular to the flow, across the duct or air handler cross-section, using durable non-metal supports in accordance with manufacturer's installation instructions. Avoid tight radius bends or kinking of the sensing element. Prevent contact between the sensing element and the duct or air handler internals. Provide a duct access door at the sensor location. The access door must be hinged on the side, factory insulated, have cam type locks, and be as large as the duct will permit, maximum 18 by 18 inches. For sensors inside air handlers, the sensors must be fully accessible through the air handler's access doors without removing any of the air handler's internals.

3.1.7.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring piping, tank, or pressure vessel temperatures. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. When installed on insulated piping, provide stand enclosure or stand off fitting to accommodate the thickness of the pipe insulation and allow for maintenance or replacement of the sensor or wiring terminations. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells must not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide the sensor well with a heat-sensitive transfer agent between the sensor and the well interior ensuring contact between the sensor and the well.

3.1.7.4 Outside Air Temperature Sensors

Provide outside air temperature sensors on the building's north side with a protective weather shade that does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain. Location must not be near exhaust hoods and other areas such that it is not influenced by radiation or convection sources which may affect the reading. Provide a shield to shade the sensor from direct sunlight.

3.1.8 Air Flow Measurement Arrays (AFMA)

Locate Outside Air AFMAs downstream from the Outside Air filters.

Install AFMAs with the manufacturer's recommended minimum distances between upstream and downstream disturbances. Airflow straighteners may be used to reduce minimum distances as recommended by the AFMA manufacturer.

3.1.9 Duct Static Pressure Sensors

Locate the duct static pressure sensing tap at 75 percent of the distance between the first and last air terminal units. If the transmitter output is a 0-10Vdc signal, locate the transmitter in the same enclosure as the air handling unit (AHU) controller for the AHU serving the terminal units. If a remote duct static pressure sensor is to be used, run the signal wire back to the controller for the air handling unit.

3.1.10 Relative Humidity Sensors

Install relative humidity sensors in supply air ducts at least 10 feet downstream of humidity injection elements.

3.1.11 Meters

3.1.11.1 Flowmeters

Install flowmeters to ensure minimum straight unobstructed piping for at least 10 pipe diameters upstream and at least 5 pipe diameters downstream of the flowmeter, and in accordance with the manufacturer's installation instructions.

3.1.11.2 Energy Meters

Locate energy meters as indicated. Connect each meter output to the DDC system, to measure both instantaneous demand/energy and other variables as indicated.

3.1.12 Dampers

3.1.12.1 Damper Actuators

Provide spring return actuators which fail to a position that protects the served equipment and space on all control dampers related to freeze protection or force protection. For all outside, makeup and relief dampers provide dampers which fail closed. Terminal fan coil units, terminal VAV units, convectors, and unit heaters nay be non-spring return unless indicated otherwise. Do not mount actuators in the air stream. Do not connect multiple actuators to a common drive shaft. Install actuators so that their action seal the damper to the extent required to maintain leakage at or below the specified rate and so that they move the blades smoothly throughout the full range of motion.

3.1.12.2 Damper Installation

Install dampers straight and true, level in all planes, and square in all dimensions. Dampers must move freely without undue stress due to twisting, racking (parallelogramming), bowing, or other installation error. External linkages must operate smoothly over the entire range of motion, without deformation or slipping of any connecting rods, joints or brackets that will prevent a return to it's normal position. Blades must close completely and leakage must not exceed that specified at the rated static pressure. Provide structural support for multi-section dampers. Acceptable methods of structural support include but are not limited to

U-channel, angle iron, corner angles and bolts, bent galvanized steel stiffeners, sleeve attachments, braces, and building structure. Where multi-section dampers are installed in ducts or sleeves, they must not sag due to lack of support. Do not use jackshafts to link more than three damper sections. Do not use blade to blade linkages. Install outside and return air dampers such that their blades direct their respective air streams towards each other to provide for maximum mixing of air streams.

3.1.13 Valves

Install the valves in accordance with the manufacturer's instructions.

3.1.13.1 Valve Actuators

Provide spring return actuators on all control valves where freeze protection is required. Spring return actuators for terminal fan coil units, terminal VAV units, convectors, and unit heaters are not required unless indicated otherwise.

3.1.14 Thermometers and Gauges

3.1.14.1 Thermometers

Mount devices to allow reading while standing on the floor or ground, as applicable.

3.1.15 Wire and Cable

Provide complete electrical wiring for the Control System, including wiring to transformer primaries. Wire and Cable must be installed without splices between control devices and in accordance with NFPA 70 and NFPA 90A. Instrumentation grounding must be installed per the device manufacturer's instructions and as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system. Test installed ground rods as specified in IEEE 142. Cables and conductor wires must be tagged at both ends, with the identifier indicated on the shop drawings. Electrical work must be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and as indicated. Wiring external to enclosures must be run in raceways

Install control circuit wiring not in raceways in a neat and safe manner. Wiring must not use the suspended ceiling system (including tiles, frames or hangers) for support. Where conduit or raceways are required, control circuit wiring must not run in the same conduit/raceway as power wiring over 50 volts. Run all circuits over 50 volts in conduit, metallic tubing, covered metal raceways, or armored cable.

3.1.16 Copper Tubing

Provide hard-drawn copper tubing in exposed areas and either hard-drawn or annealed copper tubing in concealed areas. Use only tool-made bends. Use only brass or copper solder joint type fittings, except for connections to apparatus. For connections to apparatus use brass compression type fittings.

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SECTION 23 09 23.02

BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS
02/19, CHG 1: 02/20

PART 1 GENERAL

1.1 SUMMARY

Provide a complete Direct Digital Control (DDC) system suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as specified and shown and in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.1.1 System Requirements

Provide a system meeting the requirements of both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section and with the following characteristics:

a. Except for Gateways, the control system must be an open implementation of BACnet technology using ASHRAE 135 and Fox as the communications protocols. The system must use standard ASHRAE 135 Objects and Properties and the Niagara Framework. The system must use standard ASHRAE 135 Services and the Niagara Framework exclusively for communication over the network. Gateways to packaged units must communicate with other DDC hardware using ASHRAE 135 or the Fox protocol exclusively and may communicate with packaged equipment using other protocols. The control system must be installed such that any two ASHRAE 135 devices on the Internetwork can communicate using standard ASHRAE 135 Services.

b. Install and configure control hardware to provide ASHRAE 135 Objects and Properties or Niagara Framework Objectsas indicated and as needed to meet the requirements of this specification.

c. Use Niagara Framework hardware and software exclusively for scheduling, trending, and communication with a front end (UMCS). Use Niagara Framework or standard BACnet Objects and services for alarming. Use the Fox protocol for all communication between Niagara Framework Supervisory Gateways; use the ASHRAE 135 protocol for all other building communication.

d. Use Niagara Framework Version 4.0 or later.

1.1.2 Verification of Specification Requirements

Review all specifications related to the control system installation and advise the Contracting Officer of any discrepancies before performing any work. If Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC or any other Section referenced in this specification is not included in the project specifications advise the Contracting Officer and either obtain the missing Section or obtain Contracting Officer approval before performing any work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

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

ASHRAE 135	(2020; Interpretation 1-8 2021; Errata 1-2 2021; Addenda CD 2021; Addenda BY-CE 2022; Interpretation 9-10 2022) BACnet—A Data Communication Protocol for Building Automation and Control Networks

BACNET INTERNATIONAL (BTL)

BTL Guide	(v.49; 2017) BACnet Testing Laboratory Implementation Guidelines

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3	(2022) Ethernet

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-485	(1998a; R 2012) Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

TRIDIUM, INC (TRIDIUM)

Niagara Framework	(2012) NiagaraAX User's Guide
Tridium Open NiCS	(2005) Understanding the NiagaraAX Compatibility Statement (NiCS)

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	Radio Frequency Devices (47 CFR 15)

UNDERWRITERS LABORATORIES (UL)

UL 916	(2015; Reprint Oct 2021) UL Standard for Safety Energy Management Equipment

1.3 DEFINITIONS

For definitions related to this section, see Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.4 SUBMITTALS

Submittal requirements related to this Section are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

PART 2 PRODUCTS

All products used to meet this specification must meet the indicated requirements, but not all products specified here will be required by every project. All products must meet the requirements both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section.

2.1 NETWORK HARDWARE

2.1.1 BACnet Router

All BACnet Routers must be BACnet/IP Routers and must perform layer 3 routing of ASHRAE 135 packets over an IP network in accordance with ASHRAE 135 Annex J and Clause 6. The router must provide the appropriate connection to the IP network and connections to one or more ASHRAE 135 MS/TP networks. Devices used as BACnet Routers must meet the requirements for DDC Hardware, and except for Niagara Framework Supervisory Gateways, devices used as BACnet routers must support the NM-RC-B BIBB.

2.1.2 BACnet Gateways

In addition to the requirements for DDC Hardware, the BACnet Gateway must be a Niagara Framework Supervisory Gateway or must meet the following requirements:

a. It must perform bi-directional protocol translation from one non-ASHRAE 135 protocol to ASHRAE 135. BACnet Gateways must incorporate a network connection to an ASHRAE 135 network (either BACnet over IP in accordance with Annex J or MS/TP) and a separate connection appropriate for the non-ASHRAE 135 protocol and media.

b. It must retain its configuration after a power loss of an indefinite time, and must automatically return to their pre-power loss state once power is restored.

c. It must allow bi-directional mapping of data between the non-ASHRAE 135 protocol and Standard Objects as defined in ASHRAE 135. It must support the DS-RP-B BIBB for Objects requiring read access and the DS-WP-B BIBB for Objects requiring write access.

d. It must support the DS-COV-B BIBB.

Although Gateways must meet DDC Hardware requirements , except for Niagara Framework Supervisory Gateways, they are not DDC Hardware and must not be used when DDC Hardware is required. (Niagara Framework Supervisory Gateways are both Gateways and DDC Hardware.)

2.1.3 Ethernet Switch

Ethernet Switches must be managed switches and must autoconfigure between 10,100 and 1000 megabits per second (MBPS).

2.2 CONTROL NETWORK WIRING

a. BACnet MS/TP communications wiring must be in accordance with ASHRAE 135. The wiring must use shielded, three wire (twisted-pair with reference) cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors must be less than 30 pF per foot.

b. Building Control Network Backbone IP Network must use Ethernet media.

Ethernet cables must be CAT-5e at a minimum and meet all requirements of IEEE 802.3.

2.3 DIRECT DIGITAL CONTROL (DDC) HARDWARE

2.3.1 General Requirements

All DDC Hardware must meet the following requirements:

a. It must be locally powered and must incorporate a light to indicate the device is receiving power.

b. It must conform to the BTL Guide

c. It must be BACnet Testing Laboratory (BTL) Listed.

d. The Manufacturer's Product Data submittal for each piece of DDC Hardware must include the Protocol Implementation Conformance Statement (PICS) for that hardware as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

e. It must communicate and be interoperable in accordance with ASHRAE 135 and have connections for BACnet IP or MS/TP control network wiring.

f. Other than devices controlling terminal units or functioning solely as a BACnet Router, it must support DS-COV-B, DS-RPM-A and DS-RPM-B BIBBs.

g. Devices supporting the DS-RP-A BIBB must also support the DS-COV-A BIBB.

h. Application programs, configuration settings and communication information must be stored in a manner such that they persist through loss of power:

   (1) Application programs must persist regardless of the length of time power is lost.

   (2) Configured settings must persist for any loss of power less than 2,500 hours.

   (3) Communication information, including but not limited to COV subscriptions, event reporting destinations, Notification Class Object settings, and internal communication settings, must persist for any loss of power less than 2,500 hours.

i. Internal Clocks:

   (1) Clocks in DDC Hardware incorporating a Clock must continue to function for 120 hours upon loss of power to the DDC Hardware.

   (2) DDC Hardware incorporating a Clock must support the DM-TS-B or DM-UTC-B BIBB.

j. It must have all functionality indicated and required to support the application (Sequence of Operation or portion thereof) in which it is used, including but not limited to providing Objects or Niagara Framework Points as specified and as indicated on the Points Schedule.

k. In addition to these general requirements and the DDC Hardware

Input-Output (I/O) Function requirements, all DDC Hardware must also meet any additional requirements for the application in which it is used (e.g. scheduling, alarming, trending, etc.).

l. It must meet FCC Part 15 requirements and have UL 916 or equivalent safety listing.

m. Except for Niagara Framework Supervisory Gateways, Device must support Commandable Objects to support Override requirements as detailed in PART 3 EXECUTION

n. User interfaces which allow for modification of Properties or settings must be password-protected.

o. Devices communicating BACnet MS/TP must meet the following requirements:

(1) Must have a configurable Max_Master Property.

(2) DDC Hardware other than hardware controlling a single terminal unit must have a configurable Max_Info_Frames Property.

(3) Must respond to any valid request within 50 msec with either the appropriate response or with a response of "Reply Postponed".

(4) Must use twisted pair with reference and shield (3-wire media) wiring, or twisted pair with shield (2-wire media) wiring and use half-wave rectification.

p. Devices communicating BACnet/IP must use UDP Port 0xBAC0. Devices with configurable UDP Ports must default to 0xBAC0.

q. All Device IDs, Network Numbers, and BACnet MAC addresses of devices must be fully configurable without limitation, except MS/TP MAC addresses may be limited by ASHRAE 135 requirements.

r. Except for Niagara Framework Supervisory Gateways, DDC Hardware controlling a single terminal unit must have:

(1) Objects (including the Device Object) with an Object Name Property of at least 8 characters in length.

(2) A configurable Device Object Name.

(3) A configurable Device Object Description Property at least 16 characters in length.

s. Except for Objects in either Niagara Framework Supervisory Gateways or DDC Hardware controlling a single terminal unit, all Objects (including Device Objects) must:

(1) Have a configurable Object Name Property of at least 12 characters in length.

(2) Have a configurable Object Description Property of at least 24 characters in length.

t. For programmable DDC Hardware, provide and license to the project site all programming software required to program the Hardware in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

u. For programmable DDC Hardware, provide copies of the installed application programs (all software that is not common to every controller of the same manufacturer and model) as source code compatible with the supplied programming software in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. The submitted application program must be the complete application necessary for controller to function as installed and be sufficient to allow replacement of the installed controller with another controller of the same type.

2.3.2 Hardware Input-Output (I/O) Functions

DDC Hardware incorporating hardware input-output (I/O) functions must meet the following requirements:

2.3.2.1 Analog Inputs

DC Hardware analog inputs (AIs) must be implemented using ASHRAE 135 Analog Input Objects and perform analog to digital (A-to-D) conversion with a minimum resolution of 8 bits plus sign or better as needed to meet the accuracy requirements specified in Section 23 09 00. Signal conditioning including transient rejection must be provided for each analog input. Analog inputs must be capable of being individually calibrated for zero and span. Calibration via software scaling performed as part of point configuration is acceptable. The AI must incorporate common mode noise rejection of at least 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10,000 ohms.

2.3.2.2 Analog Outputs

DDC Hardware analog outputs (AOs) must be implemented using ASHRAE 135 Analog Output Objects and perform digital to analog (D-to-A) conversion with a minimum resolution of 8 bits plus sign, and output a signal with a range of 4-20 mAdc or 0-10 Vdc. Analog outputs must be capable of being individually calibrated for zero and span. Calibration via software scaling performed as part of point configuration is acceptable. DDC Hardware with Hand-Off-Auto (H-O-A) switches for analog outputs must provide for overriding the output through the range of 0 percent to 100 percent

2.3.2.3 Binary Inputs

DDC Hardware binary inputs (BIs) must be implemented using ASHRAE 135 Binary Input Objects and accept contact closures and must ignore transients of less than 5 milli-second duration. Protection against a transient 50VAC must be provided.

2.3.2.4 Binary Outputs

DDC Hardware binary outputs (BOs) must be implemented using ASHRAE 135 Binary Output Objects and provide relay contact closures or triac outputs for momentary and maintained operation of output devices. DDC Hardware with H-O-A switches for binary outputs must provide for overriding the output open or closed.

2.3.2.4.1 Relay Contact Closures

Closures must have a minimum duration of 0.1 second. Relays must provide at least 180V of isolation. Electromagnetic interference suppression must be provided on all output lines to limit transients to 50 Vac. Minimum contact rating must be 0.5 amperes at 24 Vac.

2.3.2.4.2 Triac Outputs

Triac outputs must provide at least 180 V of isolation. Minimum contact rating must be 0.5 amperes at 24 Vac.

2.3.2.5 Pulse Accumulator

DDC Hardware pulse accumulators must be implemented using either an ASHRAE 135 Accumulator Object or an ASHRAE 135 Analog Value Object where the Present_Value is the totalized pulse count. Pulse accumulators must accept contact closures, ignore transients less than 5 msec duration, protect against
transients of 50 VAC, and accept rates of at least 20 pulses per second.

2.3.2.6 ASHRAE 135 Objects for Hardware Inputs and Outputs

The requirements for use of ASHRAE 135 objects for hardware input and outputs includes devices where the hardware sensor or actuator is integral to the controller (e.g. a VAV box with integral damper actuator, a smart sensor, a VFD, etc.)

2.3.2.7 Integrated H-O-A Switches

Where integrated H-O-A switches are provided on hardware outputs, controller must provide means of monitoring position or status of H-O-A switch. This feedback may be provided via the Niagara Framework or via any valid BACnet method, including the use of proprietary Objects, Properties, or Services.

2.3.3 Local Display Panel (LDP)

The Local Display Panels (LDPs) must be DDC Hardware with a display and navigation buttons or a touch screen display, and must provide display and adjustment of Niagara Framework points or ASHRAE 135 Properties as indicated on the Points Schedule and as specified. LDPs must be either BTL Listed as a B-OD, B-OWS, B-AWS, or be an integral part of another piece of DDC Hardware listed as a B-BC. For LDPs listed as B-OWS or B-AWS, the hardware must be BTL listed and the product must come factory installed with all applications necessary for the device to function as an LDP.

The adjustment of values using display and navigation buttons must be password protected.

2.3.4 Expansion Modules and Tethered Hardware

A single piece of DDC Hardware may consist of a base unit and also:

a. An unlimited number of hardware expansion modules, where the individual hardware expansion modules are designed to directly connect, both mechanically and electrically, to the base unit hardware. The expansion modules must be commercially available as an optional add-on to the base unit.

b. A single piece of hardware connected (tethered) to a base unit by a single cable where the cable carries a proprietary protocol between the base unit and tethered hardware. The tethered hardware must not contain control logic and be commercially available as an optional add-on to the base unit as a single package.

Note that this restriction on tethered hardware does not apply to sensors or actuators using standard binary or analog signals (not a communications protocol); sensors or actuators using standard binary or analog signals are not considered part of the DDC Hardware.

Hardware capable of being installed stand-alone, or without a separate base unit, is DDC Hardware and must not be used as expansion modules or tethered hardware.

2.3.5 Supervisory Control Requirements

2.3.5.1 Alarm Generation Hardware

Non-Niagara Framework DDC Hardware used for alarm generation must meet the following requirements:

a. Device must support the AE-N-I-B BIBB

b. The Recipient_List Property must be Writable for all Notification Class Objects used for alarm generation.

c. For all Objects implementing Intrinsic Alarming, the following Properties must be Writable:

(1) Time_Delay
(2) High_Limit
(3) Low_Limit
(4) Deadband
(5) Event_Enable
(6) If the issue date of this project specification is after 1 January 2016, Time_Delay_Normal must be writable.

d. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Notification Class Objects. It is also preferred, but not required that devices supporting the DM-OCD-B BIBB accept any valid value as an initial value for properties of Notification Class Objects.

2.3.6 Niagara Framework Supervisory Gateway

Any device implementing the Niagara Framework is a Niagara Framework Supervisory Gateway and must meet these requirements. In addition to the general requirements for all DDC Hardware, Niagara Framework Supervisory Gateway Hardware must:

a. Be direct digital control hardware.

b. Have an unrestricted interoperability license and its Niagara Compatibility Statement (NiCS) must follow the Tridium Open NiCS

Specification.

c. Manage communications between a field control network and the Niagara Framework Monitoring and Control Software, and between itself and other Niagara Framework Supervisory Gateways. Niagara Framework Supervisory Gateway Hardware must use Fox protocol for communication with other Niagara Framework Components, regardless of the manufacturer of the other components.

d. Be fully programmable using the Niagara Framework Engineering Tool and must support the following:

(1) Time synchronization, Calendar, and Scheduling using Niagara Scheduling Objects

(2) Alarm generation and routing using the Niagara Alarm Service

(3) Trending using the Niagara History Service and Niagara Trend Log Objects

(4) Integration of field control networks using the Niagara Framework Engineering Tool

(5) Configuration of integrated field control system using the Niagara Framework Engineering Tool when supported by the field control system

e. Meet the following minimum hardware requirements:

(1) One 10/100 Mbps Ethernet Port

(2) One or more MS/TP ports.

f. Provide access to field control network data and supervisory functions via web interface and support a minimum of 16 simultaneous users. Note: implementation of this capability may not be required on all projects.

g. Submit a backup of each Niagara Framework Supervisory Gateway as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. The backup must be sufficient to restore a Niagara Framework Supervisory Gateway to the final as-built condition such that a new Niagara Framework Supervisory Gateway loaded with the backup is indistinguishable in functionality from the original.

2.4 NIAGARA FRAMEWORK ENGINEERING TOOL

The Niagara Framework Engineering Tool must be Niagara Workbench or an equivalent Niagara Framework engineering tool software must:

a. Have an unrestricted interoperability license and its Niagara Compatibility Statement (NiCS) must follow the Tridium Open NiCS Specification.

b. Be capable of performing network configuration for Niagara Framework Supervisory Gateways and Niagara Framework Monitoring and Control Software.

c. Be capable of programming and configuring of Niagara Framework

Supervisory Gateways and Niagara Framework Monitoring and Control Software.

d. Be capable of discovery of Niagara Framework Supervisory Gateways and all points mapped into each Niagara Framework Supervisory Gateway and making these points accessible to Niagara Framework Monitoring and Control Software.

PART 3 EXECUTION

3.1 CONTROL SYSTEM INSTALLATION3.1.1 Niagara Framework Engineering Tool

Provide a Niagara Framework Engineering Tool.

3.1.2 Building Control Network (BCN)

Install the Building Control Network (BCN) as a single BACnet Internetwork consisting of a single IP network as the BCN Backbone and zero or more BACnet MS/TP networks. Note that in some cases there may only be a single device on the BCN Backbone.

Except for the IP Network and as permitted for the non-BACnet side of Gateways, use exclusively ASHRAE 135 networks.

3.1.2.1 Building Control Network IP Backbone

Install IP Network Cabling in conduit. Install Ethernet Switches in lockable enclosures. Install the Building Control Network (BCN) IP Backbone such that it is available at the Facility Point of Connection (FPOC) location. When the FPOC location is a room number, provide sufficient additional media to ensure that the Building Control Network (BCN) IP Backbone can be extended to any location in the room.

Use UDP port 0xBAC0 for all BACnet traffic on the IP network. (Note that in a Niagara Framework system there may not be BACnet traffic on the IP Network)

3.1.2.2 BACnet MS/TP Networks

When using MS/TP, provide MS/TP networks in accordance with ASHRAE 135 and in accordance with the ASHRAE 135 figure "Mixed Devices on 3-Conductor Cable with Shield" (Figure 9-1.4 in the 2012 version of ASHRAE 135). Ground the shield at the BACnet Router and at no other point. Ground the reference wire at the BACnet Router through a 100 ohm resistor and do not ground it at any other point. In addition:

a. Provide each segment in a doubly terminated bus topology in accordance with TIA-485.

b. Provide each segment with 2 sets of network bias resistors in accordance with ASHRAE 135, with one set of resistors at each end of the MS/TP network.

c. Use 3 wire (twisted pair and reference) with shield media for all MS/TP media installed inside. Use fiber optic isolation in accordance with ASHRAE 135 for all MS/TP media installed outside buildings, or between multiple buildings.

d. For 18 AWG cable, use segments with a maximum length of 4000 ft. When using greater distances or different wire gauges comply with the electrical specifications of TIA-485.

e. For each controller that does not use the reference wire provide transient suppression at the network connection of the controller if the controller itself does not incorporate transient suppression.

f. Install no more than 32 devices on each MS/TP segment. Do not use MS/TP to MS/TP routers.

g. Connect each MS/TP network to the BCN backbone via a Niagara Framework Supervisory Gateway configured as a BACnet Router.

h. For BACnet Routers, configure the MS/TP MAC address to 0. Assign MAC Addresses to other devices consecutively beginning at 1, with no gaps.

i. Configure the Max_Master Property of all devices to be 31.

3.1.2.3 Building Control Network (BCN) Installation

Provide a building control network meeting the following requirements:

a. Install all DDC Hardware connected to the Building Control Network.

b. Where multiple pieces of DDC Hardware are used to execute one sequence, install all DDC Hardware executing that sequence on a single MS/TP network dedicated to that sequence.

c. Traffic between BACnet networks must be exclusively via BACnet routers.

d. Use the Fox protocol for all traffic both originating and terminating at Niagara Framework components. Use the Fox protocol for all traffic originating or terminating at a Niagara Framework UMCS (including traffic to or from a future UMCS). All other traffic, including traffic between ASHRAE 135 devices and traffic between Niagara Framework Supervisory Gateways and ASHRAE 135 devices must be in accordance with ASHRAE 135.

3.1.3 DDC Hardware

Install all DDC Hardware that connects to an IP network in lockable enclosure. Install other DDC Hardware that is not in suspended ceilings in lockable enclosures. For all DDC hardware with a user interface, coordinate with site to determine proper passwords and configure passwords into device.

a. Except for zone sensors (thermostats), install all Tethered Hardware within 6 feet of its base unit.

b. Install and configure all BTL-Listed devices in a manner consistent with their BTL Listing such that the device as provided still meets all requirements necessary for its BTL Listing.

c. Install and configure all BTL-Listed devices in a manner consistent with the BTL Device Implementation Guidelines such that the device as provided meets all those Guidelines.

3.1.3.1 Device Identifiers, Network Addresses, and IP addresses

a. Do not use any Device Identifier or Network Number already used by another BACnet system at the project site..

3.1.3.2 ASHRAE 135 Object Name Property and Object Description Property

Configure the Object_Names and Object_Descriptions properties of all ASHRAE 135 Objects (including Device Objects) as indicated on the Points Schedule (Point Name and Point Description) and as specified. At a minimum:

a. Except for DDC Hardware controlling a single terminal unit, configure the Object_Name and Object_Description properties of all Objects (including Device Objects) as indicated on the Points Schedule and as specified.

b. In DDC Hardware controlling a single terminal unit, configure the Device Object_Name and Device Object_Description as indicated on the Points Schedule and as specified.

When Points Schedule entries exceed the length limitations in the device, notify Eglin DDC Shop and provide recommended alternatives for approval.

3.1.3.3 Niagara Framework Point Names and Descriptions

Configure the names and descriptions of all Points in Niagara Framework Supervisory Gateways as indicated on the Points Schedule and as specified.

3.1.3.4 Niagara Station IDs

Ensure that Niagara Station IDs of new Niagara Framework Supervisory Gateways are maintained as unique within UMCS front-end, including ensuring they do not conflict with any existing Niagara Station ID.

3.1.3.5 Hand-Off-Auto (H-O-A) Switches

Provide Hand-Off-Auto (H-O-A) switches as specified and as indicated on the Points Schedule. Provide H-O-A switches that are integral to the controller hardware, an external device co-located with (in the same enclosure as) the controller, integral to the controlled equipment, or an external device co-located with (in the same enclosure as) the controlled equipment.

a. For H-O-A switches integral to DDC Hardware, meet the requirements specified in paragraph DIRECT DIGITAL CONTROL (DDC) HARDWARE.

b. For external H-O-A switches used for binary outputs, provide for overriding the output open or closed.

c. For eternal H-O-A switches used for analog outputs, provide for overriding through the range of 0 percent to 100 percent.

3.1.3.6 Local Display Panels

Provide LDPs to display and override values of points in a Niagara Framework Supervisory Gateway or ASHRAE 135 Object Properties as indicated on the Points Schedule. Install LDPs displaying points for anything other than a terminal unit in the same room as the equipment. Install LDPs displaying points for only terminal units in a mechanical room central to the group of terminal units it serves. For LDPs using WriteProperty to commandable objects to implement an override, write values with priority 9.

3.1.3.7 MS/TP Slave Devices

Configure all MS/TP devices as Master devices. Do not configure any devices to act as slave devices.

3.1.3.8 Change of Value (COV) and Read Property

a. To the greatest extent possible, configure all devices to support the SubscribeCOV service (the DS-COV-B BIBB). At a minimum, all devices supporting the DS-RP-B BIBB, other than devices controlling only a single terminal unit, must be configured to support the DS-COV-B BIBB.

b. Whenever supported by the server side, configure client devices to use the DS-COV-A BIBB.

3.1.3.9 Engineering Units

Configure devices to use English (Inch-Pound) engineering units as follows:

a. Temperature in degrees F

b. Air or natural gas flows in cubic feet per minute (CFM)

c. Water in gallons per minute (GPM)

d. Steam flow in pounds per hour (pph)

e. Differential Air pressures in inches of water column (IWC)

f. Water, steam, and natural gas pressures in PSI

g. Enthalpy in BTU/lb

h. Heating and cooling energy in MBTU (1MBTU = 1,000,000 BTU))

i. Cooling load in tons (1 ton = 12,000 BTU/hour)

j. Heating load in MBTU/hour (1MBTU = 1,000,000 BTU)

k. Electrical Power: kilowatts (kW)

l. Electrical Energy: kilowatt-hours (kWh)

3.1.3.10 Occupancy Modes

Use the following correspondence between value and occupancy mode whenever an occupancy state or value is required:

a. OCCUPIED mode: a value of one
b. UNOCCUPIED mode: a value of two
c. WARM-UP/COOL-DOWN (PRE-OCCUPANCY) mode: a value of three

Note that elsewhere in this Section the Schedule Object is required to also support a value of four, which is reserved for future use. Also note that the behavior of a system in each of these occupancy modes is indicated in the sequence of operation for the system.

3.1.3.11 Use of BACnet Objects

Except as specifically indicated for Niagara Framework Objects, Use only standard non-proprietary ASHRAE 135 Objects and services to accomplish the project scope of work as follows:

a. Use Analog Input or Analog Output Objects for all analog hardware I/O. Do not use Analog Value Object for analog hardware I/O) .

b. Use Binary Input or Binary Output Objects for all binary hardware I/O. Do not use Binary Value Objects for binary hardware I/O.

c. Use Analog Value Objects for analog setpoints.

d. Use Accumulator Objects or Analog Value Objects for pulse inputs.

e. For occupancy modes, use Multistate Value Objects and the correspondence between value and occupancy mode specified in paragraph OCCUPANCY MODES.

f. Use a combination of Niagara Framework Alarm Extensions and Alarm Services, Intrinsic Alarming, and Notification Class Objects for alarm generation.

g. For all other points shown on the Points Schedule as requiring an ASHRAE 135 Object, use the Object type shown on the Points Schedule or, if no Object Type is shown, use a standard Object appropriate to the point.

3.1.3.11.1 Niagara Framework Objects

Points in the Niagara Framework Supervisory Gateway, even if used in a sequence or are shown on the Points Schedule, are not required to be exposed as BACnet Objects unless they are required to be available on the network by another device or sequence of operation (i.e. there is some other reason they are needed).

Use a Niagara Framework Supervisory Gateway as specified for all scheduling and trending. Use a Niagara Framework Supervisory Gateway as specified for all alarming except for intrinsic alarming.

3.1.3.12 Use of Standard BACnet Services

Except as noted in this paragraph, for all DDC Hardware (including Niagara Frameworks Supervisory Gateways when communicating with non-Niagara Framework DDC Hardware) use Standard BACnet Services as defined in this specification (which excludes some ASHRAE 135 services) exclusively for application control functionality and communication.

DDC Hardware that cannot meet this requirement may use non-standard services provided they can provide identical functionality using Standard BACnet Services when communicating with BACnet devices from a different vendor. When implementing non-standard services, document all non-standard services in the DDC Hardware Schedule as specified and as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

3.1.3.13 Device Application Configuration

a. For every property, setting or value shown on the Points Schedule or otherwise indicated as Configurable, provide a value that is retained through loss of power and can be changed via one or more of:

(1) BACnet services (including proprietary services)

(2) Hardware settings on the device

(3) The Niagara Framework

b. For every property, setting or value in non-Niagara Framework Hardware shown on the Points Schedule or otherwise indicated as Operator Configurable, provide a value that is retained through loss of power and can be changed via one or more of:

(1) A Writable Property of a standard BACnet Object

(2) A Property of a standard BACnet Object that is Writable when Out_Of_Service is TRUE and Out_Of_Service is Writable.
(3) Using some other method supported by a Niagara Framework Supervisory Gateway

c. Configure Niagara Framework Supervisory Gateways such that the property, setting or value is configurable from a Niagara Framework Front End.

d. For every property, setting or value in a Niagara Framework Supervisory Gateway which is shown on the Points Schedule or otherwise indicated as Operator Configurable, configure the value to be configurable from within the Niagara Framework such that it can be configured from a system graphic page at a Niagara Framework Front End.

3.1.3.14 Niagara Framework Engineering Tool

Use the Niagara Framework Engineering Tool to fully discover the field control system and make all field control system information available to the Niagara Framework Supervisory Gateway. Ensure that all points on the points schedule are available to the front end via the Fox protocol.

3.1.3.15 Graphics and Web Pages

Configure Niagara Framework Supervisory Gateways to use web pages to provide a graphical user interface including System Displays, including overrides, as indicated on the Points Schedule and as specified. Label all points on displays with full English language descriptions, the point name as indicated on the Points Schedule, andthe point description as indicated on the Points Schedule. Configure user permissions for access to and executions of action using graphic pages. Coordinate user permissions with the Controls shop supervisor. Configure the web server to use HTTPS based on the Transport Layer Security (TLS) protocol in accordance with RFC 5246 using a Government furnished certificate.

3.1.4 Scheduling, Alarming, Trending, and Overrides

3.1.4.1 Scheduling
Configure schedules in Niagara Framework Supervisory Gateway using Niagara Schedule Objects as indicated on the Points Schedule and as specified.

When the schedule is controlling occupancy modes in DDC Hardware other than a Niagara Framework Supervisory Gateway use the indicated correspondence between value and occupancy mode.

Provide a separate schedule for each AHU including it's associated Terminal Units and for each stand-alone Terminal Unit (those not dependent upon AHU service).

3.1.4.2 Alarm Configuration

Configure alarm generation and management as indicated on the Points Schedule and as specified. Configure alarm generation in Niagara Framework Supervisory Gateways using Niagara Framework Alarm Extensions and Alarm Services or in other DDC Hardware (not Niagara Framework Supervisory Gateways) using ASHRAE 135 Intrinsic Alarming. Configure alarm management and routing for all alarms, including those generated via intrinsic alarming in other devices, in the Niagara Framework Supervisory Gateway such that the alarms are able to be accessed from the Niagara Framework Front End.

Where Intrinsic Alarming is used, configure intrinsic alarming as specified in paragraph "Configuration of ASHRAE 135 Intrinsic Alarm Generation". Configure a Niagara Framework Supervisory Gateway to provide a means to configure the intrinsic alarm parameters such that the Intrinsic Alarm is configurable from the front end via the Niagara Framework.

3.1.4.3 Configuration of ASHRAE 135 Intrinsic Alarm Generation

Intrinsic alarm generation must meet the following requirements:

Configure alarm generation as indicated on the Points Schedule and as specified using Intrinsic Alarming in accordance with ASHRAE 135 or Algorithmic Alarming in accordance with ASHRAE 135. Alarm generation must meet the following requirements:

a. Send alarm events as Alarms (not Events).

b. Use the ConfirmedNotification Service for alarm events.

c. For alarm generation, support two priority levels for alarms: critical and non-critical. Configure the Priority of Notification Class Objects to use Priority 112 for critical and 224 for non-critical alarms.

d. Number of Notification Class Objects for Alarm Generation:

    (1) If the device implements non-critical alarms, or if any Object in the device supports Intrinsic Alarms, then provide a single Notification Class Object specifically for (shared by) all non-critical alarms.

    (2) If the device implements critical alarms, provide a single Notification Class Object specifically for (shared by) all critical alarms.

    (3) If the device implements both critical and non-critical alarms, provide both Notification Class Objects (one for critical, one for

non-critical).

(4) If the device controls equipment other than a single terminal unit, provide both Notification Class Objects (one for critical, one for non-critical) even if no alarm generation is required at time of installation.

e. For all intrinsic alarms configure the Limit_Enable Property to set both HighLimitEnable and LowLimitEnable to TRUE. If the specified alarm conditions are for a single-sided alarm (only High_Limit used or only Low_Limit used) assign a value to the unused limit such that the unused alarm condition will not occur.

f. For all objects supporting intrinsic alarming, even if no alarm generation is required during installation, configure the following Properties as follows:

(1) Notification_Class to point to the non-Critical Notification Class Object in that device.

(2) Limit_Enable to enable both the HighLimitEnable and LowLimitEnable

(3) Notify_Type to Alarm

g. Configure the Recipient_List Property of the Notification Class Object to point to the Niagara Framework Supervisory Gateway managing the alarm.

3.1.4.4 Trending

Perform all trending using a Niagara Framework Supervisory Gateway using Niagara Framework History Extensions and Niagara Framework History Service exclusively.

3.1.4.5 Overrides

Provide an override for each point shown on the Points Schedule as requiring an override. Use the Niagara Framework for all overrides to points in Niagara Framework Supervisory Gateways. For overrides to other points, provide an override to a point in a Niagara Framework Supervisory Gateway via the Niagara Framework where the Niagara Framework Supervisory Gateway overrides the other point as specified.

Unless otherwise approved, provide Commandable Objects to support all Overrides in non-Niagara Framework Supervisory Gateway DDC Hardware. With specific approval from the Contracting Officer, Overrides for points which are not hardware outputs and which are in DDC hardware controlling a single terminal unit may support overrides via an additional Object provided for the override. No other means of implementing Overrides may be used.

a. Where Commandable Objects are used, ensure that WriteProperty service requests with a Priority of 10 or less take precedence over the SEQUENCE VALUE and that WriteProperty service request with a priority of 11 or more have a lower precedence than the SEQUENCE VALUE.

b. For devices implementing overrides via additional Objects, provide

Objects which are NOT Written to as part of the normal Sequence of Operations and are Writable when Out_Of_Service is TRUE and Out_Of_Service is Writable. Use this point as an Override of the normal value when Out_Of_Service is TRUE and the normal value otherwise. Note these Objects may be modified as part of the sequence via local processes, but must not be modified by local processes when Out_Of_Service is TRUE.

3.1.5 BACnet Gateways

The requirements in this paragraph do not themselves permit the installation of hardware not meeting the other requirements of this section. Except for proprietary systems specifically indicated in Section 23 09 00, all control hardware installed under this project must meet the requirements of this specification, including the control hardware providing the network interface for a package unit or split system specified under another section. Only use gateways to connect to pre-existing control devices, and to proprietary systems specifically permitted by Section 23 09 00.

3.1.5.1 General Gateway Requirements

Provide BACnet Gateways to connect non-BACnet control hardware in accordance with the following:

a. Configure gateways to map writable data points in the controlled equipment to Writable Properties of Standard Objects, or to Niagara Framework points, as indicated in the Points Schedule and as specified.

b. Configure gateway to map readable data points in the controlled equipment to Readable Properties of Standard Objects, or to Niagara Framework points, as indicated in the Points Schedule and as specified.

c. Configure gateway to support the DS-COV-B BIBB for all points mapped to BACnet Objects.

d. Do not use non-BACnet control hardware for controlling built-up units or any other equipment that was not furnished with factory-installed controls. (Note: A Niagara Framework Supervisory Gateway is BACnet control hardware.)

e. Do not use non-BACnet control hardware for system scheduling functions.

f. Each gateway must communicate with and perform protocol translation for non-BACnet control hardware controlling one and only one package unit or a single non-BACnet system specifically permitted by Section 23 09 00.

g. Connect one network port on the gateway to the Building Control Backbone IP Network or to a BACnet MS/TP network and the other port to the single piece of controlled equipment or the non-BACnet system specifically permitted by Section 23 09 00..

h. For gateways to existing package units or simple split systems, non-BACnet network wiring connecting the gateway to the package unit must not exceed 10 feet in length and must connect to exactly two devices: the controlled equipment (packaged unit) or split system interface and the gateway.

SECTION 23 30 00

HVAC AIR DISTRIBUTION
05/20, CHG 1: 02/22

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 201	(2002; R 2011) Fans and Systems
AMCA 210	(2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(2014) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(2014) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D	(2018) Laboratory Methods of Testing Dampers for Rating

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 350	(2015) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
AHRI 410	(2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI 430	(2009) Central-Station Air-Handling Units
AHRI 440	(2008) Performance Rating of Room Fan-Coils
AHRI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(2015) Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	(2014) Load Ratings and Fatigue Life for Roller Bearings

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

ASHRAE 52.2	(2012) Method of Testing General Ventilation Air-Cleaning Devices for

	Removal Efficiency by Particle Size
ASHRAE 62.1	(2019) Ventilation for Acceptable Indoor Air Quality
ASHRAE 70	(2006; R 2021) Method of Testing the Performance of Air Outlets and Inlets
ASHRAE 90.1 - IP	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 90.1 - SI	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1	(2020) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A924/A924M	(2022) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B766	(1986; R 2015) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM C553	(2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C1071	(2019) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM D1654	(2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive

	Environments
ASTM D3359	(2017) Standard Test Methods for Rating Adhesion by Tape Test
ASTM E2016	(2022) Standard Specification for Industrial Woven Wire Cloth

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2021) Motors and Generators
NEMA MG 10	(2017) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 701	(2019) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1403	(2008) Accepted Industry Practice for Industrial Duct Construction, 2nd Edition
SMACNA 1966	(2020) HVAC Duct Construction Standards Metal and Flexible, 4th Edition

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82	Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 6	(2007; Reprint Sep 2019) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 181	(2013; Reprint Dec 2021) UL Standard for Safety Factory-Made Air Ducts and Air

	Connectors
UL 586	(2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units
UL 705	(2017; Reprint Aug 2022) UL Standard for Safety Power Ventilators
UL 900	(2015; Reprint Aug 2022) UL Standard for SafetyStandard for Air Filter Units
UL 1995	(2015; Reprint Aug 2022) UL Standard for Safety Heating and Cooling Equipment
UL Bld Mat Dir	(updated continuously online) Building Materials Directory
UL Electrical Construction	(2012) Electrical Construction Equipment Directory

1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Mechanical Equipment Identification

The number of charts and diagrams must be equal to or greater than the number of mechanical equipment rooms. Where more than one chart or diagram per space is required, mount these in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

1.2.1.1 Charts

Provide chart listing of equipment by designation numbers and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, horsepower, pipe sizes, and voltage and current characteristics.

1.2.2 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Provide labels in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Air handling unit Number	AHU - _____
Control and instrument air	CONTROL AND INSTR.

Identify similar services with different temperatures or pressures. Where pressures could exceed 125 pounds per square inch, gage, include the maximum system pressure in the label. Label and arrow piping in accordance with the following:

a. Each point of entry and exit of pipe passing through walls.

b. Each change in direction, i.e., elbows, tees.

c. In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

d. In long straight runs, locate labels at distances within eyesight of each other not to exceed 75 feet. All labels must be visible and legible from the primary service and operating area.

For Bare or Insulated Pipes	
for Outside Diameters of	Lettering
1/2 thru 1-3/8 inch	1/2 inch
1-1/2 thru 2-3/8 inch	3/4 inch
2-1/2 inch and larger	1-1/4 inch

1.2.3 Color Coding

Color coding of all piping systems must be in accordance with ASME A13.1 .

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Metallic Flexible Duct

Insulated Nonmetallic Flexible Duct Runouts

Duct Connectors

Duct Access Doors; G

Manual Balancing Dampers; G

Diffusers

Registers and Grilles

Louvers

Air Handling Units; G

Room Fan-Coil Units; G

Energy Recovery Devices; G

Indoor Air Quality for Duct Sealants

SD-06 Test Reports

Performance Tests; G

SD-07 Certificates

Ozone Depleting Substances Technician Certification

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions

Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Manual Balancing Dampers; G

Air Handling Units; G

Room Fan-Coil Units; G

Energy Recovery Devices; G

SD-11 Closeout Submittals

Indoor Air Quality During Construction

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.

c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

d. Where products are specified to meet or exceed the specified energy efficiency requirement of FEMP-designated or ENERGY STAR covered product categories, equipment selected must have as a minimum the efficiency rating identified under "Energy-Efficient Products" at http://femp.energy.gov/procurement.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Provide hot-dip galvanized ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials in accordance with ASTM A123/A123M for exterior locations and cadmium-plated in conformance with ASTM B766 for interior locations.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting refrigerants must be certified as a Section 608 Technician to meet requirements in 40 CFR 82, Subpart F. Provide copies of technician certifications to the Contracting Officer at least 14 calendar days prior to work on any equipment containing these refrigerants.

1.4.4 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.4.5 Test Procedures

Conduct performance tests as required in Section 23 05 93 Testing, Adjusting and Balancing for HVAC and Section 23 09 00 Instrumentation and Control for HVAC.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization. In product categories covered by ENERGY STAR or the Federal Energy Management Program, provide equipment that is listed on the ENERGY STAR Qualified Products List or that meets or exceeds the FEMP-designated Efficiency Requirements.

2.2 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Provide identification plates that are layers, black-white-black, engraved to show white letters on black background. Letters must be upper case. Identification plates that are 1-1/2-inches high and smaller must be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high must be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger must have beveled edges. Install identification plates using a compatible adhesive.

2.3 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard.

2.4 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Provide premium efficiency type integral size motors in accordance with NEMA MG 1.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system , and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.

d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.

e. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers are allowed to accomplish the same function. Use solid-state variable-speed controllers for motors rated 10 hp or less and adjustable frequency drives for larger motors. Provide variable frequency drives for motors as specified in Section 26 29 23 ADJUSTABLE SPEED DRIVE SYSTEMS UNDER 600 VOLTS.

2.5 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts must not degrade the surrounding concrete.

2.6 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.7 DUCT SYSTEMS

2.7.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification.

a. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.

b. Provide ductwork that meets the requirements of Seal Class A.

c. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant. Provide duct sealant products that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants are classified as "Other" within the SCAQMD Rule 1168 sealants table). Provide validation of indoor air quality for duct sealants.

d. Make spiral lock seam duct, and flat oval with duct sealant and lock with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable.

e. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

2.7.1.1 Metallic Flexible Duct

a. Provide duct that conforms to UL 181 and NFPA 90A with factory-applied insulation, vapor barrier, and end connections. Provide duct assembly that does not exceed 25 for flame spread and 50 for smoke developed. Provide ducts designed for working pressures of 2 inches water gauge positive and 1.5 inches water gauge negative. Provide flexible round duct length that does not exceed 5 feet. Secure connections by applying adhesive for 2 inches over rigid duct, apply flexible duct 2 inches over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

b. Inner duct core: Provide interlocking spiral or helically corrugated flexible core constructed of zinc-coated steel, aluminum, or stainless steel; or constructed of inner liner of continuous galvanized spring steel wire helix fused to continuous, fire-retardant, flexible vapor barrier film, inner duct core.

c. Insulation: Provide inner duct core that is insulated with mineral fiber blanket type flexible insulation, minimum of 1 inch thick. Provide insulation covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

2.7.1.2 Insulated Nonmetallic Flexible Duct Runouts

Use flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 5 feet. Provide runouts that are preinsulated, factory fabricated, and that comply with NFPA 90A and UL 181. Provide either field or factory applied vapor barrier. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene. Where coil induction or high velocity units are supplied with vertical air inlets, use a streamlined, vaned and mitered elbow transition piece for connection to the flexible duct or hose.

Provide a die-stamped elbow and not a flexible connector as the last elbow to these units other than the vertical air inlet type. Insulated flexible connectors are allowed as runouts. Provide insulated material and vapor barrier that conform to the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Do not expose the insulation material surface to the air stream.

2.7.1.3 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with NFPA 701 and is classified as "flame-retardent fabrics" in UL Bld Mat Dir.

2.7.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.7.3 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

2.7.4 Air Supply And Exhaust Air Dampers

Provide outdoor air supply and exhaust air dampers that have a maximum leakage rate when tested in accordance with AMCA 500-D as required by ASHRAE 90.1 - IP, including maximum Damper Leakage for:

a. Climate Zones 1,2,6,7,8 the maximum damper leakage at 1.0 inch w.g. for motorized dampers is 4 cfm per square foot of damper area and non-motorized dampers are not allowed.

b. All other Climate Zones the maximum damper leakage at 1.0 inch w.g. is

10 cfm per square foot and for non-motorized dampers is 20 cfm per square foot of damper area.

Dampers smaller than 24 inches in either direction may have leakage of 40 cfm per square foot.

2.7.5 Air Deflectors (Volume Extractors) and Branch Connections

Provide fixed air deflectors (volume extractors), also called turning vanes, in 90 degree elbows.

2.7.6 Plenums and Casings for Field-Fabricated Units

2.7.6.1 Plenum and Casings

Fabricate and erect plenums and casings as shown in SMACNA 1966, as applicable. Construct system casing of not less than 16 gauge galvanized sheet steel. Furnish cooling coil drain pans with 1 inch threaded outlet to collect condensation from the cooling coils. Fabricate drain pans from not lighter than 16 gauge steel, galvanized after fabrication or of 18 gauge corrosion-resisting sheet steel conforming to ASTM A167, Type 304, welded and stiffened. Thermally insulate drain pans exposed to the atmosphere to prevent condensation. Coat insulation with a flame resistant waterproofing material. Provide separate drain pans for each vertical coil section, and a separate drain line for each pan. Size pans to ensure capture of entrained moisture on the downstream-air side of the coil. Seal openings in the casing, such as for piping connections, to prevent air leakage. Size the water seal for the drain to maintain a pressure of at least 2 inch water gauge greater than the maximum negative pressure in the coil space.

2.7.6.2 Casing

Terminate casings at the curb line and bolt each to the curb using galvanized angle, as indicated in SMACNA 1966.

2.7.6.3 Access Doors

Provide access doors in each section of the casing. Weld doorframes in place, gasket each door with neoprene, hinge with minimum of two brass hinges, and fasten with a minimum of two brass tension fasteners operable from inside and outside of the casing. Where possible, make doors 36 by 18 inches and locate them 18 inches above the floor. Where the space available does not accommodate doors of this size, use doors as large as the space accommodates. Swing doors so that fan suction or pressure holds doors in closed position, airtight. Provide a push-button station, located inside the casing, to stop the supply.

2.7.6.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components are allowed for field-assembled units, provided all requirements specified for field-fabricated plenums and casings are met. Provide panels of modular design, pretested for structural strength, thermal control, condensation control, and acoustical control. Seal and insulate panel joints. Provide and gasket access doors to prevent air leakage. Provide panel construction that is not less than 20 gauge galvanized sheet steel, assembled with fasteners treated against corrosion. Provide standard length panels that deflect not more than 1/2 inch under operation. Construct details, including joint sealing, not specifically covered, as indicated in SMACNA 1966. Construct the plenums and casings to withstand the specified internal pressure of the air systems.

2.7.6.5 Duct Liner

Unless otherwise specified, duct liner is not permitted.

2.7.7 Diffusers, Registers, and Grilles

Provide factory-fabricated units of aluminum that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Provide diffusers and registers with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device is acceptable. Provide opposed blade type volume dampers for all diffusers and registers, except linear slot diffusers. Provide linear slot diffusers with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

2.7.7.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Provide air handling troffers or combination light and ceiling diffusers conforming to the requirements of UL Electrical Construction for the interchangeable use as cooled or heated air supply diffusers or return air units. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide return or exhaust units that are similar to supply diffusers.

2.7.7.2 Registers and Grilles

Provide return and exhaust registers that are fixed horizontal or vertical louver type similar in appearance to the supply register face. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Provide grilles as specified for registers, without volume control damper.

2.7.8 Louvers

Provide louvers for installation in exterior walls that are associated with the air supply and distribution system as specified in Section 08 91 00 METAL WALL LOUVERS.

2.7.9 Bird Screens and Frames

Provide bird screens that conform to ASTM E2016, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide "light" rated stainless steel screens. Provide removable type frames fabricated from either stainless steel or extruded aluminum.

2.8 AIR SYSTEMS EQUIPMENT

2.8.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans must not exceed 85 dBA when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors either directly or indirectly with V-belt drive. Use V-belt drives designed for not less than 120 percent of the connected driving capacity. Provide variable pitch motor sheaves for 15 hp and below, and fixed pitch as defined by AHRI Guideline D (A fixed-pitch sheave is provided on both the fan shaft and the motor shaft. This is a non-adjustable speed drive.). Select variable pitch sheaves to drive the fan at a speed which can produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide a replaceable sheave when needed to achieve system air balance. Provide motors for V-belt drives with adjustable rails or bases. Provide removable metal guards for all exposed V-belt drives, and provide speed-test openings at the center of all rotating shafts. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide sound power level as indicated. Obtain the sound power level values according to AMCA 300. Provide standard AMCA arrangement, rotation, and discharge as indicated. Provide power ventilators that conform to UL 705 and have a UL label.

2.8.2 Coils

Provide fin-and-tube type coils constructed of seamless copper tubes and aluminum or copper fins mechanically bonded or soldered to the tubes. Provide casing and tube support sheets that are not lighter than 16 gauge galvanized steel, formed to provide structural strength. When required, provide multiple tube supports to prevent tube sag. Mount coils for counterflow service. Rate and certify coils to meet the requirements of AHRI 410. Except for hot water coils, provide factory applied phenolic, vinyl or epoxy/electrodeposition coating.

2.8.2.1 Water Coils

Install water coils with a pitch of not less than 1/8 inch/foot of the tube length toward the drain end. Use headers constructed of cast iron, welded steel or copper. Furnish each coil with a plugged vent and drain connection extending through the unit casing. Provide removable water coils with drain pans. Pressure test coils in accordance with UL 1995.

2.8.3 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586.

2.8.3.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters of the size indicated with a MERV of 8 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.36 inches water gauge. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to the inside of the frame to prevent air bypass and increase rigidity.

2.8.3.2 Holding Frames

Fabricate frames from not lighter than 16 gauge sheet steel with rust-inhibitor coating. Equip each holding frame with suitable filter holding devices. Provide gasketed holding frame seats. Make all joints airtight.

2.8.3.3 Filter Gauges

Provide dial type filter gauges, diaphragm actuated draft for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Provide gauges that are at least 3-7/8 inches in diameter, with white dials with black figures, and graduations with a minimum range of 1 inch of water beyond the specified final resistance for the filter bank on which each gauge is applied. Provide each gauge with a screw operated zero adjustment and two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter aluminum tubing, and all hardware and accessories for gauge mounting.

2.9 AIR HANDLING UNITS

2.9.1 Field-Fabricated Air Handling Units

Provide built-up units as specified in paragraph DUCT SYSTEMS. Provide fans, coils spray-coil dehumidifiers, and air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types indicated.

2.9.2 Factory-Fabricated Air Handling Units

Provide single-zone draw-through type units as indicated. Units must include fans, coils, airtight insulated casing, prefilters, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, combination sectional filter-mixing box, vibration-isolators, and appurtenances required for specified operation. Provide vibration isolators as indicated. Physical dimensions of each air handling unit must be suitable to fit space allotted to the unit with the capacity indicated. Provide air handling unit that is rated in accordance with AHRI 430 and AHRI certified for cooling.

2.9.2.1 Casings

Provide the following:

a. Casing sections 2 inch double wall type, constructed of a minimum 18 gauge galvanized steel, or 18 gauge corrosion-resisting sheet steel conforming to ASTM A167, Type 304.Inner casing of double-wall units that are a minimum 20 gauge solid galvanized steel or corrosion-resisting sheet steel conforming to ASTM A167, Type 304. Design and construct casing with an integral insulated structural galvanized steel frame such that exterior panels are non-load bearing.

b. Individually removable exterior panels with standard tools. Removal must not affect the structural integrity of the unit. Furnish casings with access sections, according to paragraph AIR HANDLING UNITS, inspection doors, and access doors, all capable of opening a minimum of 90 degrees, as indicated.

c. Insulated, fully gasketed, double-wall type inspection and access doors, of a minimum 18 gauge outer and 20 gauge inner panels made of either galvanized steel or corrosion-resisting sheet steel conforming to ASTM A167, Type 304. Provide rigid doors with heavy duty hinges and latches. Inspection doors must be a minimum 12 inches wide by 12 inches high. Access doors must be a minimum 24 inches wide, the full height of the unit casing or a minimum of 6 foot, whichever is less.

d. Double-wall insulated type drain pan (thickness equal to exterior casing) constructed of 16 gauge corrosion resisting sheet steel conforming to ASTM A167, Type 304, conforming to ASHRAE 62.1. Construct drain pans water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils must not flow across the face of lower coils. Provide intermediate drain pans or condensate collection channels and downspouts, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Construct drain pan to allow for easy visual inspection, including underneath the coil without removal of the coil and to allow complete and easy physical cleaning of the pan underneath the coil without removal of the coil. Provide coils that are individually removable from the casing.

e. Casing insulation that conforms to NFPA 90A. Insulate single-wall casing sections handling conditioned air with not less than 1 inch thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Insulate double-wall casing sections handling conditioned air with not less than 2 inches of the same insulation specified for single-wall casings. Foil-faced insulation is not an acceptable substitute for use with double wall casing. Seal double wall insulation completely by inner and outer panels.

f. Factory applied fibrous glass insulation that conforms to ASTM C1071, except that the minimum thickness and density requirements do not apply, and that meets the requirements of NFPA 90A. Make air handling unit casing insulation uniform over the entire casing. Foil-faced insulation is not an acceptable substitute for use on double-wall access doors and inspections doors and casing sections.

g. Duct liner material, coating, and adhesive that conforms to fire-hazard requirements specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Protect exposed insulation edges and joints where insulation panels are butted with a metal nosing strip or coat to meet erosion resistance requirements of ASTM C1071.

h. A latched and hinged inspection door, in the fan and coil sections. Plus additional inspection doors, access doors and access sections where indicated.

2.9.2.2 Heating and Cooling Coils

Provide coils as specified in paragraph AIR SYSTEMS EQUIPMENT.

2.9.2.3 Air Filters

Provide air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.9.2.4 Fans

Provide the following:

a. Fans that are double-inlet, centrifugal type with each fan in a separate scroll. Dynamically balance fans and shafts prior to installation into air handling unit, then after it has been installed in the air handling unit, statically and dynamically balance the entire fan assembly. Mount fans on steel shafts, accurately ground and finished.

b. Fan bearings that are sealed against dust and dirt and are precision self-aligning ball or roller type, with L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide bearings that are permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Support bearings by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Do not fasten bearings directly to the unit sheet metal casing. Furnish fans and scrolls with coating indicated.

2.9.2.5 Access Sections and Filter/Mixing Boxes

Provide access sections where indicated and furnish with access doors as shown. Construct access sections and filter/mixing boxes in a manner identical to the remainder of the unit casing and equip with access doors. Design mixing boxes to minimize air stratification and to promote thorough mixing of the air streams.

2.10 TERMINAL UNITS

2.10.1 Room Fan-Coil Units

Provide base units that include galvanized coil casing, coil assembly drain pan air filter, fans, motor, fan drive, motor switch, an enclosure for cabinet models and casing for concealed models, leveling devices integral with the unit for vertical type units, and sound power levels as indicated. Obtain sound power level data or values for these units according to test procedures based on AHRI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models are acceptable for concealed models without separate test provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Fasten each unit securely to the building structure. Provide units with capacity indicated. Provide room fan-coil units that are certified as complying with AHRI 440, and meet the requirements of UL 1995.

2.10.1.1 Fans

Provide steel or aluminum, multiblade, centrifugal type fans. In lieu of metal, fans and scrolls could be of non-metallic materials of suitably reinforced compounds with smooth surfaces. Dynamically and statically balance the fans. Provide accessible assemblies for maintenance. Disassemble and re-assemble by means of mechanical fastening devices and not by epoxies or cements.

2.10.1.2 Coils

Fabricate coils from not less than 3/8 inch outside diameter seamless copper tubing, with copper or aluminum fins mechanically bonded or soldered to the tubes. Provide coils with not less than 1/2 inch outside diameter flare or sweat connectors, accessory piping package with thermal connections suitable for connection to the type of control valve supplied, and manual air vent. Test coils hydrostatically at 300 psi or under water at 250 psi air pressure. Provide coils suitable for 200 psi working pressure. Make provisions for coil removal.

2.10.1.3 Drain Pans

Size and locate drain and drip pans to collect all water condensed on and dripping from any item within the unit enclosure or casing. Provide condensate drain pans designed for self-drainage to preclude the buildup of microbial slime and thermally insulated to prevent condensation and constructed of not lighter than 21 gauge type 304 stainless steel or noncorrosive ABS plastic. Provide insulation with a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and of a waterproof type or coated with a waterproofing material. Design drain pans so as to allow no standing water and pitch to drain. Provide minimum 3/4 inch NPT or 5/8 inch OD drain connection in drain pan. Provide plastic or metal auxiliary drain pans to catch drips from control and piping packages, eliminating insulation of the packages; if metal, provide auxiliary pans that comply with the requirements specified above. Extend insulation at control and piping connections 1 inch minimum over the auxiliary drain pan.

2.10.1.4 Filters

Provide disposable type filter that complies with ASHRAE 52.2. Provide filters in each unit that are removable without the use of tools.

2.11 ENERGY RECOVERY DEVICES

2.11.1 Desiccant Wheel

Provide counterflow supply, regeneration airstreams, a rotary type dehumidifier designed for continuous operation, and extended surface type wheel structure in the axial flow direction with a geometry that allows for laminar flow over the operating range for minimum air pressure differentials. Provide the dehumidifier complete with a drive system utilizing a fractional-horsepower electric motor and speed reducer assembly driving the rotor. Include a slack-side tensioner for automatic take-up for belt-driven wheels. Provide an adsorbing type desiccant material. Apply the desiccant material to the wheel such that the entire surface is active as a desiccant and the desiccant material does not degrade or detach from the surface of the wheel which is fitted with full-face, low-friction contact seals on both sides to prevent cross leakage. Provide rotary structure that has underheat, overheat and rotation fault circuitry. Provide wheel assembly with a warranty for a minimum of five years.

2.12 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D1654, and ASTM D3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D520 Type I.

Field paint factory painting that has been damaged prior to acceptance by the Contracting Officer in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

2.13 SUPPLEMENTAL COMPONENTS/SERVICES

2.13.1 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate in accordance with Section 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS except as modified herein.

2.13.2 Backflow Preventers

The requirements for backflow preventers are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of the manufacturer's required maintenance access. feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices)and an additional 3 feet.

c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units. Provide a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 6 inch concrete pads or curbs doweled in place unless otherwise indicated. Make concrete foundations heavy enough to minimize the intensity of the vibrations transmitted to the piping, duct work and the surrounding structure, as recommended in writing by the equipment manufacturer. In lieu of a concrete pad foundation, build a concrete pedestal block with isolators placed between the pedestal block and the floor. Make the concrete foundation or concrete pedestal block a mass not less than three times the weight of the components to be supported. Provide the lines connected to the pump mounted on pedestal blocks with flexible connectors. Submit foundation drawings as specified in paragraph DETAIL DRAWINGS.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.2.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.6 FRP Ductwork

Provide fibrous glass reinforced plastic ducting and related structures that conform to SMACNA 1403. Provide flanged joints where indicated. Crevice-free butt lay-up joints are acceptable where flanged joints are not indicated. When ambient temperatures are lower than 50 degrees F, heat cure joints by exothermic reaction heat packs.

3.2.7 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate outdoor air intake ducts and plenums.

3.2.8 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

3.2.9 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.3 EQUIPMENT PADS

Provide equipment pads to the dimensions shown or, if not shown, to conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports. Allow equipment bases and foundations, when constructed of concrete or grout, to cure a minimum of 14 calendar days before being loaded.

3.4 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

3.5 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.6 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C553, Type 1, Class B-2.

3.6.1 Sleeves

Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A53/A53M, Schedule 20.

3.6.2 Framed Prepared Openings

Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.

3.6.3 Insulation

Provide duct insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS continuous through sleeves and prepared openings.

3.6.4 Firestopping

Where ducts pass through fire-rated walls, fire partitions, and fire rated chase walls, seal the penetration with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING.

3.7 FIELD PAINTING OF MECHANICAL EQUIPMENT

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except clean to bare metal on metal surfaces subject to temperatures in excess of 120 degrees F. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Provide aluminum or light gray finish coat.

3.7.1 Temperatures less than 120 degrees F

Immediately after cleaning, apply one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat to metal surfaces subject to temperatures less than 120 degrees F.

3.8 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.9 DUCTWORK LEAK TEST

The requirements for ductwork leak tests are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC.

3.10 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.11 PERFORMANCE TESTS

Conduct performance tests as required in Section 23 05 93 Testing, Adjusting and Balancing for HVAC and Section 23 09 00 Instrumentation and Control for HVAC.

3.12 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and provide new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Perform and document that proper "Indoor Air Quality During Construction" procedures have been followed; provide documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.13 OPERATION AND MAINTENANCE

3.13.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data

3.13.2 Operation And Maintenance Training

Conduct a training course for the members of the operating staff as designated by the Contracting Officer. Make the training period consist of a total of 8 hours of normal working time and start it after all work specified herein is functionally completed and the Performance Tests have been approved. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed On-site Training schedule concurrently with the Operation and Maintenance Manuals and at least 14 days prior to conducting the training course.

-- End of Section --

SECTION 23 81 00

DECENTRALIZED UNITARY HVAC EQUIPMENT
05/18, CHG 1: 02/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 340/360 I-P	(2015) Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
AHRI 700	(2016) Specifications for Fluorocarbon Refrigerants

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

ASHRAE 15 & 34	(2013) ASHRAE Standard 34-2016 Safety Standard for Refrigeration Systems/ASHRAE Standard 34-2016 Designation and Safety Classification of Refrigerants-ASHRAE Standard 34-2016
ASHRAE 90.1 - IP	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 90.1 - SI	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1	(2021) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM C1071	(2019) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2021) Motors and Generators
NEMA MG 2	(2014) Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-5541	(2006; Rev F) Chemical Conversion Coatings on Aluminum and Aluminum Alloys

UNDERWRITERS LABORATORIES (UL)

UL 1995	(2015; Reprint Aug 2022) UL Standard for Safety Heating and Cooling Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Spare Parts

Posted Instructions

Coil Corrosion Protection

System Performance Tests

Training; G

Inventory

Supplied Products

Manufacturer's Standard Catalog Data

SD-06 Test Reports

System Performance Tests; G

SD-07 Certificates

Service Organizations

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

SD-11 Closeout Submittals

Ozone Depleting Substances

1.3 QUALITY ASSURANCE

Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Submit drawings consisting of:

a. Equipment layouts which identify assembly and installation details.

b. Plans and elevations which identify clearances required for maintenance and operation.

c. Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.

d. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.

e. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

f. Automatic temperature control diagrams and control sequences.

g. Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

h. Equipment schedules

1.4 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Properly protect and care for all material both before and during installation. Submit an inventory of all the stored items. Replace any materials found to be damaged, at no additional cost to the Government. During installation, cap piping and similar openings capped to keep out dirt and other foreign matter.

1.5 WARRANTY

Provide equipment with the Manufacturer's Standard Warranty.

PART 2 PRODUCTS

2.1 ENERGY EFFICIENCY REQUIREMENTS

42 USC 8259b requires the procurement of energy efficient products in product categories covered by the Energy Star program or the Federal Energy Management Program for designated products. A list of covered product categories is available from the Federal Energy Management Web site at http://energy.gov/eere/femp/covered-product-categories.

Submit Material, Equipment, and Fixtures List of all supplied products within a covered product category, including manufacturer's catalog numbers, specification and drawing reference number, warranty information, fabrication site, and energy performance data. For product categories covered by the Federal Energy Management Program, submit documentation that the product meets or exceeds FEMP-designated efficiency requirements.

2.2 MATERIALS

Provide Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data includes manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit data for each specified component. Minimum efficiency requirements must be in accordance with ASHRAE 90.1 - IP.

2.2.1 Standard Products

Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products must have been in satisfactory commercial or industrial use for 2 years prior to request for proposal. The 2 year use includes applications of equipment and materials under similar circumstances and of similar size. The 2 years' experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products must be supported by a service organization. Ensure system components are environmentally suitable for the indicated geographic locations.

2.2.2 Product Sustainability Criteria

2.2.2.1 Energy Efficient Equipment

Provide equipment meeting the efficiency requirements as stated within this section.

2.2.2.2 Electrical Equipment / Motors

Provide electrical equipment, motors, motor efficiencies, and wiring which are in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical motor driven equipment specified must be provided complete with motors, motor starters, and controls. Electrical characteristics must be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, must be the premium efficiency type in accordance with NEMA MG 1. Field wiring must be in accordance with manufacturer's instructions. Each motor must conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors must be continuous duty with the enclosure specified. Motor starters must be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors must be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors must be sized for the applicable loads. Motor torque must be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings must be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, must be provided.

2.2.2.3 Ozone Depleting Substances

Unitary air conditioning equipment must not use CFC-based refrigerants. Refrigerant may be an approved alternative refrigerant in accordance with EPA's Significant New Alternative Policy (SNAP) listing.

2.2.3 Nameplates

Major equipment including compressors, condensers, receivers, heat exchanges, fans, and motors must have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates must be durable and legible throughout equipment life and made of anodized aluminum. Fix plates in prominent locations with nonferrous screws or bolts.

2.2.4 Safety Devices

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.

2.3 EQUIPMENT

2.3.1 Mini-Split-System Air Conditioners and Heat Pumps

2.3.1.1 Large-Capacity Split-System Air Conditioners (Greater Than 65,000 Btu/h)

Provide an air-cooled, split system which employs a remote condensing unit, a separate floor mounted indoor unit, and interconnecting refrigerant piping. Provide the air conditioning type with hot gas reheat for DOAS-1A and heat pump type for AHU-1A and AHU-2A conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit must be rated in accordance with AHRI 340/360 I-P. Provide unit with necessary fans, air filters, and cabinet construction as specified in paragraph UNITARY EQUIPMENT ACCESSORIES. Provide double-width, double inlet, forward curved centrifugal scroll type evaporator or supply fans. Provide the manufacturer's standard for the unit specified and may be propeller type condenser or outdoor fans. Enclose fan condenser motors in totally enclosed enclosures and permanently lubricate ball bearings. Provide DOAS-1A with hot gas reheat.

2.3.1.1.1 Air-To-Refrigerant Coil

Provide coils with copper tubes tubes of 3/8 inch minimum diameter with aluminum fins that are mechanically bonded or soldered to the tubes. Provide casing of galvanized steel. Avoid contact of dissimilar metals. Test coils in accordance with ASHRAE 15 & 34 at the factory and ensure suitability for the working pressure of the installed system. Dehydrate and seal each coil testing and prior to evaluation and charging. Provide each unit with a factory operating charge of refrigerant and oil or a holding charge. Field charge unit shipped with a holding charge with refrigerant and oil. Provide separate expansion devices for each compressor circuit. Condenser coil must have special coating for corrosion resistance.

Coat condenser and evaporator coil with a uniformly applied epoxy electrodeposition type coating to all coil surface areas without material bridging between fins. Apply coating at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation and be capable of withstanding a minimum `500 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.3.1.1.2 Compressor

Provide direct drive, semi-hermetic or hermetic reciprocating, or scroll type compressor capable of operating at partial load conditions. Compressor must be capable of continuous operation down to the lowest step of unloading as specified. Equip compressors of 10 tons and larger with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. If standard with the manufacturer, two or more compressors may be used in lieu of a single compressor with unloading capabilities, in which case the compressors operate in sequence, and each compressor has an independent refrigeration circuit through the condenser and evaporator. Start compressors in the unloaded position. Provide each compressor with vibration isolators, crankcase heater, thermal overloads, high and low pressure safety cutoffs and protection against short cycling.

2.3.1.1.3 Refrigeration Circuit

Refrigerant-containing components must comply with ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Provide refrigerant charging valves and connections, and pumpdown valves for each circuit. Provide reversible-flow type filter-drier in each liquid line. Refrigerant flow control devices must be an adjustable superheat thermostatic expansion valve with external equalizer matched to coil, capillary or thermostatic control, and a pilot solenoid controlled, leak-tight, four-way refrigerant flow reversing valve. Provide a refrigerant suction line thermostatic control to prevent freeze-up in event of loss of water flow during heating cycle.

2.3.1.1.4 Primary/Supplemental Heat

Provide heating unit with internal thermal insulation having a fire hazard rating not to exceed 25 for flame spread and 50 for smoke developed as determined by ASTM E84.

2.3.1.1.4.1 Electric Heating

Provide electric duct heater in accordance with UL 1995 and NFPA 70. Coil must be completely assembled, unit-mounted, and integral to the unit. Provide coil with nickel chromium elements and a maximum density of 40 watts per square inch. Provide coil with automatic reset high limit control operating through heater backup contactors. Provide coil casing and support brackets of galvanized steel or aluminum. Mount coil to eliminate noise from expansion and contraction and be completely accessible for service.

Construct electric heater of heavy-duty nickel chromium elements. Achieve staging through the unit control processor. Each heater must have automatically reset high limit control. Heaters must be individually fused from the factory and comply with NEC requirements. Power assemblies must provide single point connection. Electric heat modules must be listed and labeled by a national recognized testing laboratory acceptable to authorities having jurisdiction. Electric heater controls must confirm the supply fan is operating before electric elements are energized. Operate electric heater in 2 stages for AHU-1A and AHU-2A when outdoor ambient is too low to maintain space thermostat setting with compressor operation. For DOAS-1A, operate electric heater using silicon control rectifier (SCR) control.

2.3.1.1.5 Unit Controls

Provide unit internally prewired with a volt control circuit powered by an internal transformer. Provide terminal blocks for power wiring and external control wiring. Unit must have cutoffs for high and low pressure, and low oil pressure for compressors with positive displacement oil pumps, supply fan failure, and safety interlocks on all service panels. Head pressure controls must sustain unit operation with ambient temperature of 20degrees F. Adjustable-cycle timers must prevent short-cycling. Stage multiple compressors by means of a time delay. Internally protect unit by fuses or a circuit breaker in accordance with UL 1995.

Controls must include a control system interface to a BACnet Control system. The control system interface, as well as any network between physically separate units, must meet the requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

2.4 COMPONENTS

2.4.1 Refrigerant and Oil

Refrigerant must be one of the fluorocarbon gases. Refrigerants must have number designations and safety classifications in accordance with ASHRAE 15 & 34. Refrigerants must meet the requirements of AHRI 700 as a minimum. Provide a complete charge of refrigerant for the installed system as recommended by the manufacturer. Lubricating oil must be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge must be in accordance with manufacturer's recommendation.

2.4.2 Fans

Fan wheel shafts must be supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans must be selected to produce the cfm required at the fan total pressure. Motor starters, if applicable, must be magnetic across-the-line type with a totally enclosed enclosure. Thermal overload protection must be of the manual or automatic-reset type. Fan wheels or propellers must be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings must be of galvanized steel, and both centrifugal and propeller fan casings must be constructed of aluminum or galvanized steel. Steel elements of fans, except fan shafts, must be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting must be recoated with an approved zinc-rich compound. Fan wheels or propellers must be statically and dynamically balanced.

2.4.3 Cabinet Construction

Casings for the specified unitary equipment must be constructed of galvanized steel or aluminum sheet metal and galvanized or aluminum structural members. Minimum thickness of single wall exterior surfaces must be 18 gauge galvanized steel or 0.071 inch thick aluminum on units with a capacity above 20 tons and 20 gauge galvanized steel or 0.064 inch thick aluminum on units with a capacity less than 20 tons. Casing must be fitted with lifting provisions, access panels or doors, fan vibration isolators, electrical control panel, corrosion-resistant components, structural support members, insulated condensate drip pan and drain, and internal insulation in the cold section of the casing. Where double-wall insulated construction is proposed, minimum exterior galvanized sheet metal thickness must be 20 gauge. Provisions to permit replacement of major unit components must be incorporated. Penetrations of cabinet surfaces, including the floor, must be sealed. Unit must be fitted with a drain pan which extends under all areas where water may accumulate. Drain pan must be fabricated from Type 300 stainless steel, galvanized steel with protective coating as required, or an approved plastic material. Pan insulation must be water impervious. Extent and effectiveness of the insulation of unit air containment surfaces must prevent, within limits of the specified insulation, heat transfer between the unit exterior and ambient air, heat transfer between the two conditioned air streams, and condensation on surfaces. Insulation must conform to ASTM C1071.

2.5 FINISHES

2.5.1 Coil Corrosion Protection

Provide coil with a uniformly applied epoxy electrodeposition, phenolic, or vinyl type coating to all coil surface areas without material bridging between fins. Submit product data on the type coating selected, the coating thickness, the application process used, the estimated heat transfer loss of the coil, and verification of conformance with the salt spray test requirement. Coating must be applied at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation. Coating must be capable of withstanding a minimum 1,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.5.2 Equipment and Components Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, must be factory finished with the manufacturer's standard finish, except that items located outside of buildings must have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen must show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used must be coated with a zinc-rich coating conforming to ASTM D520, Type I.

Where stipulated in equipment specifications of this section, coat finned tube coils of the affected equipment as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating must show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins.

2.5.2.1 Phenolic Coating

Provide a resin base thermosetting phenolic coating. Apply coating by immersion dipping of the entire coil. Provide a minimum of two coats. Bake or heat dry coils following immersions. After final immersion and prior to final baking, spray entire coil with particular emphasis given to building up coating on sheared edges. Total dry film thickness must be 2.5 to 3.0 mils.

2.5.2.2 Chemical Conversion Coating with Polyelastomer Finish Coat

Dip coils in a chemical conversion solution to molecularly deposit a corrosion resistant coating by electrolysis action. Chemical conversion coatings must conform to MIL-DTL-5541, Class 1A. Cure conversion coating at a temperature of 110 to 140 degrees F for a minimum of 3 hours. Coat coil surfaces with a complex polymer primer with a dry film thickness of 1 mil. Cure primer coat for a minimum of 1 hour. Using dip tank method, provide three coats of a complex polyelastomer finish coat. After each of the first two finish coats, cure the coils for 1 hour. Following the third coat, spray a fog coat of an inert sealer on the coil surfaces. Total dry film thickness must be 2.5 to 3.0 mils. Cure finish coat for a minimum of 3 hours. Coating materials must have 300 percent flexibility, operate in temperatures of minus 50 to plus 220 degrees F, and protect against atmospheres of a pH range of 1 to 14.

2.5.2.3 Vinyl Coating

Apply coating using an airless fog nozzle. For each coat, make at least two passes with the nozzle. Materials to be applied are as follows:

a. Total dry film thickness, 6.5 mils maximum

b. Vinyl Primer, 24 percent solids by volume: One coat 2 mils thick

c. Vinyl Copolymer, 30 percent solids by volume: One coat 4.5 mils thick

2.5.3 Factory Applied Insulation

Refrigeration equipment must be provided with factory installed insulation on surfaces subject to sweating including the suction line piping. Where motors are the gas-cooled type, factory installed insulation must be provided on the cold-gas inlet connection to the motor in accordance with manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors must have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces must have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes must be determined by ASTM E84. Insulation must be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket must be tested as a composite material. Jackets, facings, and adhesives must have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E84.

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

All manufactured units must be inspected and tested, and documentation provided to demonstrate that each unit is in compliance with ANSI/AHRI and UL requirements and that the minimum efficiency requirements of ASHRAE 90.1 - IP have been met.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform Verification of Dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION

Perform work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPVC SEC VIII D1and ASME BPVC SEC IX, the design, fabrication, and installation of the system must conform to ASME BPVC SEC VIII D1 and ASME BPVC SEC IX.

3.2.1 Equipment

Provide refrigeration equipment conforming to ASHRAE 15 & 34. Provide necessary supports for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, and similar items.

3.3 CLEANING AND ADJUSTING

Equipment must be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters must be provided for all fans that are operated during construction, and new filters must be installed after all construction dirt has been removed from the building. System must be maintained in this clean condition until final acceptance. Bearings must be properly lubricated with oil or grease as recommended by the manufacturer. Belts must be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment must be adjusted to setting indicated or directed. Fans must be adjusted to the speed indicated by the manufacturer to meet specified conditions. Testing, adjusting, and balancing must be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.4 TRAINING

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of a total 4 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests.

a. Submit a schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

b. Submit the field posted instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions must include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions must be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

c. The posted instructions must cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations. Submit 6 complete copies of an operation manual in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 2 weeks prior to the training course. The booklets must include the manufacturer's name, model number, and parts list. The manuals must include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

d. Submit 6 complete copies of maintenance manual in bound 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals must include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

3.5 SYSTEM PERFORMANCE TESTS

Before each refrigeration system is accepted, conduct tests to demonstrate the general operating characteristics of all equipment by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Six copies of the report provided in bound 8-1/2 by 11 inch booklets. The report must document compliance with the specified performance criteria upon completion and testing of the system. The report must indicate the number of days covered by the tests and any conclusions as to the adequacy of the system.

For equipment providing heating and cooling the system performance tests must be performed during the heating and cooling seasons.

a. Submit a schedule, at least 2 weeks prior to the start of related testing, for the system performance tests. The schedules must identify the proposed date, time, and location for each test. Tests must cover a period of not less than 48 hours for each system and must demonstrate that the entire system is functioning in accordance with the drawings and specifications.

b. Make corrections and adjustments, as necessary, tests must be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, install and tighten service valve seal caps and blanks over gauge points. Replace any refrigerant lost during the system startup.

c. If tests do not demonstrate satisfactory system performance, correct deficiencies and retest the system. Conduct tests in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Provide all material, equipment, instruments, and personnel required for the test.

d. Coordinate field tests with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Submit 6 copies of the report provided in bound 8-1/2 by 11 inch booklets. The report must document compliance with the specified performance criteria upon completion and testing of the system. The report must indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. Submit the report including the following information (where values are taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart):

   (1) Date and outside weather conditions.

   (2) The load on the system based on the following:

      (a) The refrigerant used in the system.
      (b) Condensing temperature and pressure.
      (c) Suction temperature and pressure.
      (d) Ambient, condensing and coolant temperatures.
      (e) Running current, voltage and proper phase sequence for each phase of all motors.

   (3) The actual on-site setting of operating and safety controls.

   (4) Thermostatic expansion valve superheat - value as determined by

field test.

(5) Subcooling.

(6) High and low refrigerant temperature switch set-points

(7) Low oil pressure switch set-point.

(8) Defrost system timer and thermostat set-points.

(9) Moisture content.

(10) Capacity control set-points.

(11) Field data and adjustments which affect unit performance and energy consumption.

(12) Field adjustments and settings which were not permanently marked as an integral part of a device.

3.6 MAINTENANCE

3.6.1 EXTRA MATERIALS

Submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

3.6.2 Maintenance Service

Submit a certified list of qualified permanent service organizations, which includes their addresses and qualifications, for support of the equipment. The service organizations must be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

-- End of Section --

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SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM
08/23

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	(2023) National Electrical Safety Code
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA NEIS 1	(2015) Standard for Good Workmanship in Electrical Construction

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2020) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI C80.3	(2020) American National Standard for Electrical Metallic Tubing (EMT)
ANSI C80.5	(2020) American National Standard for Electrical Rigid Aluminum Conduit

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2022) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA KS 1	(2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(2014) Dry-Type Transformers for General Applications
NEMA TC 2	(2020) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2021) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA VE 2	(2018; ERTA 1-2 2018) Cable Tray Installation Guidelines
NEMA WD 1	(1999; R 2020) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2021) Wiring Devices Dimensions Specifications
NEMA Z535.4	(2011; R 2017) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code
NFPA 70E	(2024) Standard for Electrical Safety in the Workplace
NFPA 780	(2023) Standard for the Installation of Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568.1	(2020e) Commercial Building Telecommunications Infrastructure Standard
TIA-569	(2019e; Add 1 2022) Telecommunications Pathways and Spaces
TIA-607	(2019d) Generic Telecommunications Bonding and Grounding (Earthing) for Customer

Premises

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 431	Energy Efficiency Program for Certain Commercial and Industrial Equipment
29 CFR 1910.147	The Control of Hazardous Energy (Lock Out/Tag Out)
29 CFR 1910.303	Electrical, General

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jan 2022) UL Standard for Safety Flexible Metal Conduit
UL 6	(2022) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 6A	(2008; Reprint Mar 2021) UL Standard for Safety Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
UL 20	(2018; Reprint May 2023) UL Standard for Safety General-Use Snap Switches
UL 44	(2018; Reprint May 2021) UL Standard for Safety Thermoset-Insulated Wires and Cables
UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 67	(2018; Reprint Aug 2023) UL Standard for Safety Panelboards
UL 83	(2017; Reprint Mar 2020) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 360	(2013; Reprint Apr 2023) UL Standard for Safety Liquid-Tight Flexible Metal Conduit
UL 467	(2022) UL Standard for Safety Grounding and Bonding Equipment
UL 486A-486B	(2018; Reprint Jul 2023) UL Standard for Safety Wire Connectors
UL 486C	(2018; Reprint May 2021) UL Standard for Safety Splicing Wire Connectors
UL 489	(2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 498	(2017; Reprint May 2023) UL Standard for Safety Attachment Plugs and Receptacles

UL 510	(2020; Dec 2022) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2013; Reprint Jun 2022) UL Standard for Safety Metallic Outlet Boxes
UL 514B	(2012; Reprint May 2020) Conduit, Tubing and Cable Fittings
UL 514C	(2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(2011; Reprint May 2022) UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL 797	(2007; Reprint Apr 2023) UL Standard for Safety Electrical Metallic Tubing -- Steel
UL 869A	(2006; Reprint Jun 2020) Reference Standard for Service Equipment
UL 943	(2016; Reprint Sep 2023) UL Standard for Safety Ground-Fault Circuit-Interrupters
UL 1242	(2006; Reprint Apr 2022) UL Standard for Safety Electrical Intermediate Metal Conduit -- Steel
UL 1449	(2021; Reprint Dec 2022) UL Standard for Safety Surge Protective Devices
UL 1561	(2011; Reprint Aug 2023) Dry-Type General Purpose and Power Transformers
UL 1660	(2019; Reprint Jan 2022) Liquid-Tight Flexible Nonmetallic Conduit
UL 2043	(2023) Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Panelboards; G

Transformers; G

Cable Trays; G

Marking Strips Drawings; SD-03 Product Data

Receptacles; G

Circuit Breakers; G

Switches; G

Transformers; G

Motor Controllers; G

Manual Motor Starters; G

Secondary Bonding Busbar; G

Surge Protective Devices; G

Cable Trays; G

SD-06 Test Reports

600-volt Wiring Test; G

Transformer Tests; G

Ground-fault Receptacle Test; G

SD-09 Manufacturer's Field Reports

Transformer Factory Tests

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5; G

1.4 QUALITY ASSURANCE

1.4.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with NFPA 70 unless more stringent requirements are specified or indicated. NECA NEIS 1 shall be considered the minimum standard for workmanship.

1.4.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.5 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein. Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. Include the following:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

Provide equipment items supported by service organizations that are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

As a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70 for all materials, equipment, and devices.

2.2 CONDUIT AND FITTINGS

Conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

ANSI C80.1, UL 6.

2.2.1.2 Rigid Aluminum Conduit

ANSI C80.5, UL 6A.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2,UL 651.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, ANSI C80.3.

2.2.5 Plastic-Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40(40 mils thick).

2.2.6 Flexible Metal Conduit

UL 1, limited to 6 feet.

2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360, limited to 6 feet.

2.2.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings: cadmium- or zinc-coated in accordance with UL 514B.

2.2.7.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT

Steel compression type.

2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.2.9 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.3 CABLE TRAYS

NEMA VE 2. Provide the following:

a. Cable trays: form a wireway system, with a nominal depth as indicated. Cable tray is to have a span/load class designation of _5AA_ per NEMA VE 2.

b. Cable trays: constructed of aluminum.

c. Cable trays: include splice and end plates, dropouts, and miscellaneous hardware.

d. Edges, fittings, and hardware: finished free from burrs and sharp edges.

e. Fittings: ensure not less than load-carrying ability of straight tray sections and have manufacturer's minimum standard radius.

f. Radius of bends: as indicated.

2.3.1 Basket-Type Cable Trays

Provide size as indicated with maximum wire mesh spacing of 2 by 4 inch. Basket trays shall have solid bottom inserts.

2.3.2 Ladder-Type Cable Trays

Provide size as indicated with maximum rung spacing of9 inches. Cable tray must be suitable for use as an equipment grounding conductor.

2.4 OPEN TELECOMMUNICATIONS CABLE SUPPORT

2.4.1 Open Top Cable Supports

Provide open top cable supports in accordance with UL 2043. Provide galvanized open top cable supports as indicated.

2.5 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.5.1 Floor Outlet Boxes

Provide the following:

a. Boxes: adjustable and concrete tight.

b. Each outlet: consisting of nonmetallic or cast-metal body with threaded openings, or sheet-steel body with knockouts for conduits, adjustable, brass flange ring, and cover plate with1 1/4 inch threaded plug.

c. Telecommunications outlets: consisting of flush, aluminum or stainless steel housing with a receptacle as specified and one inch bushed side opening.

d. Receptacle outlets: consisting of flush aluminum or stainless steel housing with duplex-type receptacle as specified herein.

e. Provide gaskets where necessary to ensure watertight installation.

2.5.2 Outlet Boxes for Telecommunications System

Provide the following:

a. Standard type 4 inches square by 3 1/2 inches deep.

b. Outlet boxes for wall-mounted telecommunications outlets: 4 by 2 1/8 by 2 1/8 inches deep.

c. Depth of boxes: large enough to allow manufacturers' recommended conductor bend radii.

d. Outlet boxes for fiber optic telecommunication outlets: include a minimum 3/8 inch deep single or two gang plaster ring as shown and installed using a minimum one inch conduit system.

2.6 CABINETS, JUNCTION BOXES, AND PULL BOXES

UL 50; volume greater than 100 cubic inches, NEMA Type 1 enclosure; sheet steel, hot-dip, zinc-coated. Where exposed to wet, damp, or corrosive environments, NEMA Type 3R as indicated.

2.7 WIRES AND CABLES

Provide wires and cables in accordance applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Do not use wires and cables manufactured more than 24 months prior to date of delivery to site.

2.7.1 Conductors

Provide the following:

a. Conductor sizes and capacities shown are based on copper, unless indicated otherwise.

b. Conductors No. 8 AWG and larger diameter: stranded.

c. Conductors No. 10 AWG and smaller diameter: solid.

d. Conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3: stranded unless specifically indicated otherwise.

e. All conductors: copper.

2.7.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.7.1.2 Minimum Conductor Sizes

Provide minimum conductor size in accordance with the following:

a. Branch circuits: No. 12 AWG.

b. Class 1 remote-control and signal circuits: No. 14 AWG.

c. Class 2 low-energy, remote-control and signal circuits: No. 16 AWG.

d. Class 3 low-energy, remote-control, alarm and signal circuits: No. 22 AWG.

e. Digital low voltage lighting control (DLVLC) system at 24 Volts or less: Category 5 UTP cables in EMT conduit.

2.7.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

2.7.2.1 Ground and Neutral Conductors

Provide color coding of ground and neutral conductors as follows:

a. Grounding conductors: Green.

b. Neutral conductors: White.

c. Exception, where neutrals of more than one system are installed in same raceway or box, other neutrals color coding: white with a different colored (not green) stripe for each.

2.7.2.2 Ungrounded Conductors

Provide color coding of ungrounded conductors in different voltage systems as follows:

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

2.7.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, provide power and lighting wires rated for 600-volts, Type THWN/THHN conforming to UL 83 or Type XHHW or RHW conforming to UL 44, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits: Type TW or TF, conforming to UL 83. Where equipment or devices require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.7.4 Bonding Conductors

ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.7.4.1 Telecommunications Bonding Backbone (TBB)

Provide a copper conductor TBB in accordance with TIA-607 with No. 6 AWG minimum size, and sized at 2 kcmil per linear foot of conductor length up to a maximum size of 750 kcmil. Provide insulated TBB with insulation as specified in the paragraph INSULATION and meeting the fire ratings of its pathway.

2.7.4.2 Bonding Conductor for Telecommunications

Provide a copper conductor Bonding Conductor for Telecommunications between the telecommunications main grounding busbar (PBB) and the electrical service ground in accordance with TIA-607. Size the bonding conductor for telecommunications the same as the TBB.

2.8 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires: insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.9 DEVICE PLATES

Provide the following:

a. UL listed, one-piece device plates for outlets to suit the devices installed.

b. For metal outlet boxes, plates on unfinished walls: zinc-coated sheet steel or cast metal having round or beveled edges.

c. For nonmetallic boxes and fittings, other suitable plates may be provided.

d. Plates on finished walls: nylon or lexan, minimum 0.03 inch wall thickness and same color as receptacle or toggle switch with which they are mounted.

f. Screws: machine-type with countersunk heads in color to match finish of plate.

g. Sectional type device plates are not be permitted.

h. Plates installed in wet locations: gasketed and UL listed for "wet locations."

2.10 SWITCHES

2.10.1 Toggle Switches

NEMA WD 1, UL 20, single pole, three-way, and four-way, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Include the following:

a. Handles: white thermoplastic.

b. Wiring terminals: screw-type, side-wired or of the solderless pressure type having suitable conductor-release arrangement.

c. Contacts: silver-cadmium and contact arm - one-piece copper alloy.

d. Switches: rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.10.2 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Utilize Class R fuseholders and fuses for fused switches, unless indicated otherwise. Provide horsepower rated for switches serving as the motor-disconnect means. Provide switches in NEMA, enclosure as indicated per NEMA ICS 6.

2.11 RECEPTACLES

Provide the following:

a. UL 498, general purpose specification grade, grounding-type. Residential grade receptacles are not acceptable.

b. Ratings and configurations: as indicated.

c. Bodies: white as per NEMA WD 1.

d. Face and body: thermoplastic supported on a metal mounting strap.

e. Dimensional requirements: per NEMA WD 6.

f. Screw-type, side-wired wiring terminals or of the solderless pressure type having suitable conductor-release arrangement.

g. Grounding pole connected to mounting strap.

h. The receptacle: containing triple-wipe power contacts and double or triple-wipe ground contacts.

2.11.1 Weatherproof Receptacles

Provide receptacles, UL listed for use in "wet locations" with integral GFCI protection. Include cast metal box with gasketed, hinged, lockable and weatherproof while-in-use, polycarbonate, UV resistant/stabilized extra-duty rated hood.

2.11.2 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Provide device capable of detecting current leak when the current to ground is 6 milliamperes or higher, and tripping per requirements of UL 943 for Class A ground-fault circuit interrupter devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.12 PANELBOARDS

Provide panelboards in accordance with the following:

a. UL 67 and UL 50 having a short-circuit current rating as indicated.

b. Panelboards for use as service disconnecting means: additionally conform to UL 869A.

c. Panelboards: circuit breaker-equipped.

d. Designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL.

e. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the design drawings. If it is not possible to match "specific breaker placement" during construction, obtain Government approval prior to device installation.

f. Use of "Subfeed Breakers" is not acceptable.

g. Main breaker: "separately" mounted "above" or "below" branch breakers.

h. Where "space only" is indicated, make provisions for future installation of breakers.

i. Directories: indicate load served by each circuit in panelboard.

j. Directories: indicate source of service to panelboard (e.g., Panel PA served from Panel MDP).

k. Provide new directories for existing panels modified by this project as indicated.

l. Type directories and mount in holder behind transparent protective covering.

m. Panelboards: listed and labeled for their intended use.

n. Panelboard nameplates: provided in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.12.1 Enclosure

Provide panelboard enclosure in accordance with the following:

a. UL 50.

b. Cabinets mounted outdoors or flush-mounted: hot-dipped galvanized after fabrication.

c. Cabinets: painted in accordance with paragraph FIELD APPLIED PAINTING.

d. Outdoor cabinets: NEMA 3R raintight with conduit hubs welded to the cabinet.

e. Front edges of cabinets: form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front.

f. All cabinets: fabricated such that no part of any surface on the finished cabinet deviates from a true plane by more than 1/8 inch.

g. Holes: provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface.

h. Flush doors: mounted on hinges that expose only the hinge roll to view when the door is closed.

i. Each door: fitted with a combined catch and lock latch.

j. Keys: two provided with each lock, with all locks keyed alike.

k. Finished-head cap screws: provided for mounting the panelboard fronts on the cabinets.

2.12.2 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.12.2.1 Panelboard Neutrals for Non-Linear Loads

Provide in accordance with the following:.

a. UL listed, with panelboard type specifically UL heat rise tested for use on non-linear loads.

b. Panelboard: heat rise tested in accordance with UL 67, except with the neutral assembly installed and carrying 200 percent of the phase bus current during testing.

c. Verification of the testing procedure: provided upon request.

d. Two neutral assemblies paralleled together with cable is not acceptable.

e. Nameplates for panelboard rated for use on non-linear loads: marked "SUITABLE FOR NON-LINEAR LOADS" and in accordance with paragraph FIELD FABRICATED NAMEPLATES.

f. Provide a neutral label with instructions for wiring the neutral of panelboards rated for use on non-linear loads.

2.12.3 Circuit Breakers

UL 489, thermal magnetic-type and solid state-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker will be mounted. Breaker terminals: UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.12.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.12.3.2 Circuit Breaker With Ground-Fault Circuit Interrupter

UL 943 and NFPA 70. Provide with auto-monitoring (self-test) and lockout features, "push-to-test" button, visible indication of tripped condition, and ability to detect and trip when current imbalance is 6 milliamperes or higher per requirements of UL 943 for Class A ground-fault circuit interrupter devices.

2.13 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated.

2.14 TRANSFORMERS

Provide transformers in accordance with the following:

a. NEMA ST 20, general purpose, dry-type, self-cooled, ventilated.

b. Provide transformers in NEMA 1 enclosure.

c. Taps for transformers 15 kVA and larger: Two 2.5 percent taps Full Capacity Above Nominal (FCAN) and four 2.5 percent taps Full Capacity Below Nominal (FCBN).

d. Transformer insulation system:

(1) 220 degrees C insulation system for transformers 15 kVA and greater, with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C.

(2) 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 80 degrees C under full-rated load in maximum ambient of 40 degrees C.

e. Transformer of 150 degrees C temperature rise is not acceptable.

f. Transformer of 115 degrees C temperature rise: capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

2.14.1 Specified Transformer Efficiency

Transformers, indicated and specified with: 480V primary, 80 degrees C or 115 degrees C temperature rise, kVA ratings of 37.5 to 100 for single phase or 30 to 500 for three phase, energy efficient type. The transformer is not acceptable if the calculated transformer efficiency is less than the efficiency indicated in 10 CFR 431, Subpart K.

2.14.2 K-Rated Transformers

Provide K-rated transformers for non-linear loads in accordance with the following:

a. Transformer insulation: UL recognized 220 degrees C system. Neither the primary nor the secondary temperature is allowed to exceed 220 degrees C at any point in the coils while carrying their full rating of non-sinusoidal load.

b. Transformers are to be UL listed and labeled for K-13 in accordance with UL 1561.

c. Transformers evaluated by the UL K-Factor evaluation: listed for 115 degrees C average temperature rise only.

d. Transformers with K-Factor ratings with temperature rise of 150 degrees C rise are not acceptable.

e. K-Factor rated transformers impedance: allowed range of 3 percent to 5 percent, with a minimum reactance of 2 percent to prevent excessive neutral current when supplying loads with large amounts of third harmonic.

2.15 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single pole designed for surface mounting with overload protection.

2.16 LOCKOUT REQUIREMENTS

Provide circuit breakers, disconnecting means, and other devices that are electrical energy-isolating capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147, NFPA 70E and 29 CFR 1910.303. Comply with requirements of Division 23, "Heating, Ventilating, and Air Conditioning (HVAC)" for mechanical isolation of machines and other equipment.

2.17 TELECOMMUNICATIONS SYSTEM

Provide system of telecommunications wire-supporting structures (pathway), including: outlet boxes, conduits with pull wires cable trays, and other accessories for telecommunications outlets and pathway in accordance with TIA-569 and as specified herein. Additional telecommunications requirements are specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.18 GROUNDING AND BONDING EQUIPMENT

2.18.1 Ground Rods

UL 467. Ground rods: cone pointed copper-clad steel], with minimum diameter of 3/4 inch and minimum length60 feet. Sectional type rods may be used for rods 20 feet or longer.

2.18.2 Ground Bus

Copper ground bus: provided in the electrical equipment rooms as indicated.

2.18.3 Secondary Bonding Busbar

Provide corrosion-resistant grounding busbar suitable for indoor installation in accordance with TIA-607. Busbars: plated for reduced contact resistance. If not plated, clean the busbar prior to fastening the conductors to the busbar and apply an anti-oxidant to the contact area to control corrosion and reduce contact resistance. Provide a Secondary bonding busbar (SBB) in all other telecommunications rooms and equipment rooms. The Secondary bonding busbar (SBB): sized in accordance with the immediate application requirements and with consideration of future growth. Provide Secondary bonding busbars with the following:

a. Predrilled copper busbar provided with holes for use with standard sized lugs,

b. Minimum dimensions of 0.25 in thick by 4 in wide for the PBB and 2 in wide for SBBs with length as indicated;

c. Listed by a nationally recognized testing laboratory.

2.19 MANUFACTURER'S NAMEPLATE

Provide on each item of equipment a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.20 FIELD FABRICATED NAMEPLATES

Provide field fabricated nameplates in accordance with the following:

a. ASTM D709.

b. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.

c. Each nameplate inscription: identify the function and, when applicable, the position.

d. Nameplates: melamine plastic, 0.125 inch thick, white with black center core.

f. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.

g. Minimum size of nameplates: one by 2.5 inches.

h. Lettering size and style: a minimum of 0.25 inch high normal block style.

2.21 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA Z535.4 for switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. Provide marking that is clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.22 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with NFPA requirements.

2.23 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices (SPD) which comply with UL 1449 at the , panelboards. Provide surge protectors in a NEMA 1 enclosure per NEMA ICS 6. Do not install SPD inside a panelboard or switchboard enclosure. However, SPD may be installed in a separate compartment of a switchgear provided that it is supplied by a dedicated circuit breaker. SPD must have the same short-circuit current rating as the protected equipment and must not be installed at a point of system where the available fault current is in excess of that rating. Use Type 1 or Type 2 SPD and connect on the load side of a dedicated circuit breaker. Submit performance and characteristic curves.

Provide the following modes of protection:

FOR SINGLE PHASE AND THREE PHASE WYE CONNECTED SYSTEMS-
Phase to phase (L-L)
Each phase to neutral (L-N)
Neutral to ground (N-G)]
Phase to ground (L-G)]

SPDs at the service entrance: provide with a minimum surge current rating of 80,000 amperes for L-L mode minimum and 40,000 amperes for other modes (L-N, L-G, and N-G) and downstream SPDs rated 40,000 amperes for L-L mode minimum and 20,000 amperes for other modes (L-N, L-G, and N-G).

Provide SPDs per NFPA 780 for the lightning protection system.

Maximum L-N, and N-G Voltage Protection Rating:

700V for 208Y/120V, three phase system
1,200V for 480Y/277V, three phase system

Maximum L-G Protection Rating:

700V for 208Y/120V, three phase system
1,200V for 480Y/277V, three phase system

Maximum L-L Voltage Protection Rating:

1,200V for 208Y/120V, three phase system
1,800V for 480Y/277V, three phase system

The minimum MCOV (Maximum Continuous Operating Voltage) rating for L-N and L-G modes of operation: 120 percent of nominal voltage for 240 volts and below; 115 percent of nominal voltage above 240 volts to 480 volts.

2.24 FACTORY APPLIED FINISH

Provide factory-applied finish on electrical equipment in accordance with the following:

a. NEMA 250 corrosion-resistance test and the additional requirements as specified herein.

b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.

c. Exterior surfaces: free from holes, seams, dents, weld marks, loose scale or other imperfections.

d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.

e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.

f. Equipment located indoors: ANSI Light Gray, and equipment located outdoors: ANSI Light Gray.

g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.25 SOURCE QUALITY CONTROL

2.25.1 Transformer Factory Tests

Submittal: include routine NEMA ST 20 transformer test results on each transformer and also provide the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces: conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Shared neutral, or multi-wire branch circuits, are not permitted with arc-fault circuit interrupters. Minimum conduit size: 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings: made with metal conduit in fire-rated shafts, with metal conduit extending through shafts for minimum distance of 6 inches. Firestop conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors in accordance with NFPA requirements.

3.1.1.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.2 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits under floor slab as if exposed.

3.1.2.1 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use in hazardous areas.

e. Do not use outdoors.

f. Do not use in fire pump rooms.

g. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.2.2 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40.

(1) Do not use where subject to physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, fire pump rooms, and where restrictions are applying to both PVC Schedule 40 and PVC Schedule 80.

(2) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

b. PVC Schedule 80.

(1) Do not use where subject to physical damage, including but not limited to, hospitals, power plant, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

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3.1.2.3 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.2.4 Underground Conduit

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40 Plastic coating: extend minimum 6 inches above floor.

3.1.2.5 Conduit Through Floor Slabs

Where conduits rise through floor slabs, do not allow curved portion of bends to be visible above finished slab. Where conduit rises through slab-on grade, seal all electrical penetrations to address radon mitigation and prevent infiltration of air, insects, and vermin.

3.1.2.6 Conduit Installed in Concrete Floor Slabs or Concrete Walls

Rigid steel; steel IMC; fiberglass, or PVC, Type EPC-40.PVC, Type EPC-40, unless indicated otherwise. Locate so as not to adversely affect structural strength of slabs or penetrate RF shielding. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends must not be visible above finish slab. Increase slab thickness as necessary to provide minimum one inch cover over conduit. Where embedded conduits cross building expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings must allow horizontal and vertical movement of raceway. Conduit larger than one inch trade size: installed parallel with or at right angles to main reinforcement; when at right angles to reinforcement, install conduit close to one of supports of slab. Where nonmetallic conduit is used, convert raceway to plastic coated rigid steel or plastic coated steel IMC before rising above floor, unless specifically indicated.

3.1.2.7 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.2.8 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit hangers, or ceiling trapeze. Plastic cable ties are not acceptable. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Do not exceed one-fourth proof test load for load applied to fasteners. Provide vibration resistant and shock-resistant fasteners attached to concrete ceiling. Do not cut main reinforcing bars for any holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems: supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Do not share supporting means between electrical raceways and mechanical piping or ducts. Identify independent conduit support in both fire and non-fire rated assemblies per NFPA 70. Coordinate installation with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.2.9 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.2.10 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Provide locknuts with sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.2.11 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size: 1/2 inch diameter. Provide liquid tight flexible nonmetallic conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections. Plastic cable ties are not acceptable as a support method.

3.1.2.12 Telecommunications and Signal System Pathway

Install telecommunications pathway in accordance with TIA-569.

a. Horizontal Pathway: Telecommunications pathways from the work area to the telecommunications room: installed and cabling length requirements in accordance with TIA-568.1. Size conduits, and cable trays in accordance with TIA-569 and as indicated.

b. Backbone Pathway: Telecommunication pathways from the telecommunications entrance facility to telecommunications rooms, and, telecommunications equipment rooms (backbone cabling): installed in accordance with TIA-569. Size conduits, and cable trays] for telecommunications risers in accordance with TIA-569 and as indicated.

3.1.3 Cable Tray Installation

Install and ground in accordance with NFPA 70. In addition, install and ground telecommunications cable tray in accordance with TIA-569, and TIA-607. Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Cable tray and tray supports must not partially nor completely obstruct access to the room. Support in accordance with NEMA VE 2 and with manufacturer recommendations but at not more than6 foot intervals. Coat contact surfaces of aluminum connections with an antioxidant compound prior to assembly. Adjacent cable tray sections: bonded together by connector plates of an identical type as the cable tray sections. For grounding of cable tray system provide No. 2 AWG bare copper wire throughout cable tray system, and bond to each section, except use No. 1/0 aluminum wire if cable tray is aluminum. Terminate cable trays 10 inches from both sides of smoke and fire partitions. Install conductors run through smoke and fire partitions in 4 inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Firestop penetrations in accordance with NFPA requirements. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.4 Telecommunications Cable Support Installation

Install open top and closed ring cable supports on 4 ft to 5 ft centers to adequately support and distribute the cable’s weight. Use these types of supports to support a maximum of 50 0.25 in diameter cables. Install suspended cables with at least 3 in of clear vertical space above the ceiling tiles and support channels (T-bars). Open top and closed ring cable supports: suspended from or attached to the structural ceiling or walls with hardware or other installation aids specifically designed to support their weight.

3.1.5 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways: cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, and when specifically indicated. Boxes in other locations: sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic sheathed cable conduit system. Provide each box with volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures: minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls: square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; provide readily removable fixtures for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lock washers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.5.1 Boxes

Boxes for use with raceway systems: minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets: minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet.

3.1.5.1.1 Wall-Mounted Telecommunications Outlet Box

Provide double gang electrical boxes,4 inches square and3 1/2 inches deep with plaster ring for connection of single gang faceplate. Design outlet box for recess mounting with the faceplate flush with the wall surface, at the same height as the electrical outlets.

3.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, and compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.5.3 Extension Rings

Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.6 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of center of grip of the operating handle of the switch or circuit breaker at its highest position is maximum 79 inches above floor or working platform or as allowed in Section 404.8 per NFPA 70. Mount lighting switches 48 inches above finished floor. Mount receptacles and telecommunications outlets 18 inches above finished floor, unless otherwise indicated. Wall-mounted telecommunications outlets: mounted at height 60 inches above finished floor. Mount other devices as indicated. Measure mounting heights of wiring devices and outletsto center of device or outlet.

3.1.7 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, provide color coding by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS. and manufacturer's recommendations. Provide telecommunications system conductor identification as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS.

3.1.7.1 Marking Strips

Provide marking strips for identification of power distribution, control, data, and communications cables in accordance with the following:

a. Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations.

b. Use permanent ink for the wire numbers

c. Provide reversible marking strips to permit marking both sides, or provide two marking strips with each block.

d. Size marking strips to accommodate the two sets of wire numbers.

e. Assign a device designation in accordance with NEMA ICS 1 to each device to which a connection is made. Mark each device terminal to which a connection is made with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams.

f. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations.

g. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.8 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.10 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.11 Grounding and Bonding

Provide in accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, grounding conductor of nonmetallic sheathed cables, and neutral conductor of wiring systems. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA-607. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.11.1 Ground Rods

Provide ground rods and measure the resistance to ground using the fall-of-potential method described in IEEE 81.

3.1.11.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic weld or high compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make high compression connections using a hydraulic or electric compression tool to provide the correct circumferential pressure. Provide tools and dies as recommended by the manufacturer. Use an embossing die code or other standard method to provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.11.3 Ground Bus

Provide a copper ground bus in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment: effectively grounded by bonding to the ground bus. Bond the ground bus to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Make connections and splices of the brazed, welded, bolted, or pressure-connector type, except use pressure connectors or bolted connections for connections to removable equipment.

3.1.11.4 Telecommunications System

Provide telecommunications grounding in accordance with the following:

a. Telecommunications Grounding Busbars: Provide a Secondary bonding busbar (SBB) in all other telecommunications rooms and telecommunications equipment rooms. Install the SBB as close to the telecommunications room panelboard as practicable, when equipped. Where a panelboard for telecommunications equipment is not installed in the telecommunications room, locate the SBB near the backbone cabling and associated terminations. In addition, locate the SBB to provide for the shortest and straightest routing of the grounding conductors. Where a panelboard for telecommunications equipment is located within the same room or space as a SBB, bond that panelboard's alternating current equipment ground (ACEG) bus (when equipped) or the panelboard enclosure to the SBB. Install Secondary bonding busbars to maintain clearances as required by NFPA 70 and insulated from its support. A minimum of 2 inches separation from the wall is recommended to allow access to the rear of the busbar and adjust the mounting height to accommodate overhead or underfloor cable routing.

b. Telecommunications Bonding Conductors: Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in ferrous metallic conduit that exceeds 3 feet in length, bond the conductors to each end of the conduit using a grounding bushing or a No. 6 AWG conductor, minimum. Provide a telecommunications bonding backbone (TBB) that originates at the PBB extends throughout the building using the telecommunications backbone pathways, and connects to the SBBs in all telecommunications rooms and equipment rooms. Install the TBB conductors such that they are protected from physical and mechanical damage. The TBB conductors should be installed without splices and routed in the shortest possible straight-line path. Make the bonding conductor between a TBB and a SBB continuous. Where splices are necessary, the number of splices should be a minimum. Make the splices accessible and located in telecommunications spaces. Connect joined segments of a TBB using exothermic welding, irreversible compression-type connectors, or equivalent. Install all joints to be adequately supported and protected from damage. Whenever two or more TBBs are used within a multistory building, bond the TBBs together with a grounding equalizer (GE) at the top floor and at a minimum of every third floor in between. Do not connect the TBB and GE to the pathway ground, except at the PBB or the SBB.

c. Telecommunications Grounding Connections: Telecommunications grounding connections to the SBB: utilize listed compression two-hole lugs, exothermic welding, suitable and equivalent one hole non-twisting lugs, or other irreversible compression type connections. Bond all metallic pathways, cabinets, and racks for telecommunications cabling and interconnecting hardware located within the same room or space as the SBB. In a metal frame (structural steel) building, where the steel framework is readily accessible within the room; bond each SBB to the vertical steel metal frame using a minimum No. 6 AWG conductor. Where the metal frame is external to the room and readily accessible, bond the metal frame to the SBB or PBB with a minimum No. 6 AWG conductor. When practicable because of shorter distances and, where horizontal steel members are permanently electrically bonded to vertical column members, the SBB may be bonded to these horizontal members in lieu of the vertical column members. All connectors used for bonding to the metal frame of a building must be listed for the intended purpose.

3.1.12 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications and are provided under the section specifying the associated equipment.

3.1.13 Government-Furnished Equipment

Contractor rough-in for Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.14 Repair of Existing Work

Perform repair of existing work, demolition, and modification of existing electrical distribution systems as described in the construction documents.

3.1.14.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.14.2 Existing Concealed Wiring to be Removed

Disconnect existing concealed wiring to be removed from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.14.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment includes equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, back to equipment's power source as indicated.

3.1.14.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Maintain existing circuits of equipment energized. Restore circuits wiring and power which are to remain but were disturbed during demolition back to original condition.

3.1.15 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible. Maximum allowed lead length is 3 feet avoiding 90 degree bends. Do not locate surge protective devices inside a panelboard or switchboard enclosure.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets. Provide nameplate on all equipment in access controlled spaces and areas.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Where field painting of enclosures for panelboards, load centers or the like is specified to match adjacent surfaces, to correct damage to the manufacturer's factory applied coatings, or to meet the indicated or specified safety criteria, provide manufacturer's recommended coatings and apply in accordance to manufacturer's instructions.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test s. Where applicable, test electrical equipment in accordance with NETA ATS.

3.5.1 Devices Subject to Manual Operation

Operate each device subject to manual operation at least five times, demonstrating satisfactory operation each time.

3.5.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of 1,000 volts DC for 600 volt rated wiring and 500 volts DC for 300 volt rated wiring per NETA ATS to provide direct reading of resistance. All existing wiring to be reused must also be tested.

3.5.3 Transformer Tests

Perform the standard, not optional, tests in accordance with the Inspection and Test Procedures for transformers, dry type, air-cooled, 600 volt and below; as specified in NETA ATS. Measure primary and secondary voltages for proper tap settings. Tests need not be performed by a recognized independent testing firm or independent electrical consulting firm.

3.5.4 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed. Press the TEST button and then the RESET button to verify by LED status that the device is a self-test model as specified in UL 943.

-- End of Section --

SECTION 26 29 23

ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS
02/20, CHG 1: 05/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

EUROPEAN COMMITTEE FOR STANDARDIZATION (CEN/CENELEC)

EN 61800-3	(2017) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519	(2022) Standard for Harmonic Control in Electrical Power Systems
IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61000-3-12	(2012) Electromagnetic Compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and </=75 A per phase

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 3.1	(2019) Guide for the Application, Handling, Storage, Installation and Maintenance of Medium-Voltage AC Contactors, Controllers and Control Centers
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA ICS 7	(2020) Adjustable-Speed Drives

NEMA ICS 7.2	(2015) Application Guide for AC Adjustable Speed Drive Systems
NEMA MG 1	(2021) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 489	(2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 61800-5-1	(2016) Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements - Electrical, Thermal and Energy

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM applies to this section with additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Performance Requirements

1.3.1.1 Electromagnetic Interference Suppression

Computing devices, as defined by 47 CFR 15 and EN 61800-3 rules and regulations, must be certified to comply with the requirements for class A computing devices and labeled.

1.3.1.2 Electromechanical and Electrical Components

Ensure electrical and electromechanical components of the Adjustable Speed Drive (ASD) do not cause electromagnetic interference to adjacent electrical or electromechanical equipment while in operation.

1.3.2 Electrical Requirements

1.3.2.1 Power Line Surge Protection

IEEE C62.41.1 and IEEE C62.41.2, IEEE 519, IEC 61000-3-12 Control panel must have surge protection, included within the panel to protect the unit from damaging transient voltage surges. Surge protective device must be mounted near the incoming power source and properly wired to all three phases and ground. Fuses must not be used for surge protection.

1.3.2.2 Sensor and Control Wiring Surge Protection

I/O functions as specified must be protected against surges induced on control and sensor wiring installed outdoors and as shown. Test the inputs and outputs in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Schematic Diagrams; G

Interconnecting Diagrams; G

Installation Drawings; G

As-Built Drawings; G

SD-03 Product Data

Adjustable Speed Drives; G

Wires and Cables

Equipment Schedule

SD-06 Test Reports

ASD Test

Performance Verification Tests

Endurance Test

SD-07 Certificates

Testing Agency's Field Supervisor NETA Certificate; G

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

ASD Test Plan; G

Standard Products

SD-10 Operation and Maintenance Data

1.5 QUALITY ASSURANCE

1.5.1 Schematic Diagrams

Submit diagrams showing circuits and device elements for each replaceable module. Schematic diagrams of printed circuit boards are permitted to group functional assemblies as devices, provided that sufficient information is provided for government maintenance personnel to verify proper operation of the functional assemblies.

1.5.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.5.3 Installation Drawings

Show floor plan of each site, with ASD's and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes. Submit drawings for government approval prior to equipment construction or integration. Immediately record modifications to original drawings made during installation for inclusion into the as-built drawings.

1.5.4 Equipment Schedule

Provide schedule of equipment supplied. Schedule must provide a cross reference between manufacturer data and identifiers indicated in shop drawings. Schedule must include the total quantity of each item of equipment supplied and data indicating compatibility with motors being driven. For complete assemblies, such as ASD's, provide the serial numbers of each assembly, and a sub-schedule of components within the assembly. Provide recommended spare parts listing for each assembly or component.

1.5.5 Installation Instructions

Provide installation instructions issued by the manufacturer of the equipment, including notes and recommendations, prior to shipment to the site. Provide operation instructions prior to acceptance testing.

1.5.6 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6 DELIVERY AND STORAGE

Store delivered equipment to protect from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 WARRANTY

The complete system must be warranted by the manufacturer for a period of one year. Repair or replace any component failing to perform its function as specified and documented at no additional cost to the Government. Items repaired or replaced must be warranted for an additional period of at least one year from the date that it becomes functional again, as specified in FAR 52.246-21 Warranty of Construction.

1.8 MAINTENANCE

1.8.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

1.8.2 Operation and Maintenance Data

Provide in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Provide additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit. Include copies of as-built submittals. Provide routine preventative maintenance instructions, and equipment required. Provide instructions on how to modify program settings, and modify the control program. Provide instructions on drive adjustment, trouble-shooting, and configuration. Provide instructions on process tuning and system calibration.

1.8.3 Maintenance Support

During the warranty period, provide on-site, on-call maintenance services by drive manufacturer's personnel on the following basis: The service must be on a per-call basis with 36 hour response. Contractor is responsible for the maintenance of all hardware and software of the system during the warranty period. Various personnel of different expertise must be sent on-site depending on the nature of the maintenance service required. Costs must include travel, local transportation, living expenses, and labor rates of the service personnel while responding to the service request. The provisions of this Section are not in lieu of, nor relieve the Contractor of, warranty responsibilities covered in this specification. Should the result of the service request be the uncovering of a system defect covered under the warranty provisions, all costs for the call, including the labor necessary to identify the defect, must be borne by the Contractor.

1.8.4 Technical Support

Provide the ASDs with manufacturer's technical telephone support in English, readily available during normal working hours.

PART 2 PRODUCTS

2.1 ADJUSTABLE SPEED DRIVES (ASD)

Provide adjustable speed drive to control the speed of induction motor(s). The ASD must include the following minimum functions, features and ratings.

a. Input circuit breaker per UL 489 with a minimum of 10,000 amps symmetrical interrupting capacity and door interlocked external operator.

b. A converter stage per UL 61800-5-1 must change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter must utilize a full wave bridge design incorporating diode rectifiers. Silicon Controlled Rectifiers (SCR) are not acceptable. The converter must be insensitive to three phase rotation of the ac line and must not cause displacement power factor of less than .95 lagging under any speed and load condition.

c. An inverter stage must change fixed dc voltage to variable frequency, variable ac voltage for application to a standard NEMA MG 1 Part 30 motor designed for use with adjustable frequency power supplies. Switch the inverter to produce a sine coded pulse width modulated (PWM) output waveform.

d. The ASD shall be capable of supplying 110 percent of rated full load current for one minute at maximum ambient temperature.

e. The ASD must be designed to operate from a 480 volt, plus or minus 10 percent, three phase, 60 Hz supply, and control motors with a corresponding voltage rating.

f. Acceleration and deceleration time must be independently adjustable from one second to 60 seconds.

Required deceleration time may be achieved using not only dynamic braking resistor but with other methods described in NEMA ICS 7.2-2015 paragraph 5.2.5.

g. Adjustable full-time current limiting must limit the current to a preset value which must not exceed 110 percent of the controller rated current. The current limiting action must maintain the V/Hz ratio constant so that variable torque can be maintained. Short time starting override must allow starting current to reach 175 percent of controller rated current to maximum starting torque.

h. The controllers must be capable of producing an output frequency over the range of 3 Hz to 60 Hz (20 to one speed range), without low speed cogging. Over frequency protection must be included such that a failure in the controller electronic circuitry must not cause frequency to exceed 110 percent of the maximum controller output frequency selected.

i. Minimum and maximum output frequency must be adjustable over the following ranges: 1) Minimum frequency 3 Hz to 50 percent of maximum selected frequency; 2) Maximum frequency 40 Hz to 60 Hz.

j. The controller efficiency at any speed must not be less than 96 percent.

k. The controllers must be capable of being restarted into a motor coasting in the forward direction without tripping.

l. Protection of power semiconductor components must be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controllers to any of the following conditions must not result in component failure or the need for fuse replacement:

(1) Short circuit at controller output

(2) Ground fault at controller output

(3) Open circuit at controller output

(4) Input undervoltage

(5) Input overvoltage

(6) Loss of input phase

(7) AC line switching transients

(8) Instantaneous overload

(9) Sustained overload exceeding 115 percent of controller rated current

(10) Over temperature

(11) Phase reversal

m. Solid state motor overload protection must be included such that current exceeding an adjustable threshold must activate a 60 second timing circuit. Should current remain above the threshold continuously for the timing period, the controller will automatically shut down.

n. Include slip compensation circuit that will sense changing motor load conditions and adjust output frequency to provide speed regulation of NEMA MG 1 Part 30 designed for use with adjustable frequency power supplies motors to within plus or minus 0.5 percent of maximum speed without the necessity of a tachometer generator.

o. The ASD must be factory set for manual restart after the first protective circuit trip for malfunction (overcurrent, undervoltage, overvoltage or overtemperature) or an interruption of power. The ASD must be capable of being set for automatic restart after a selected time delay. If the drive faults again within a specified time period (adjustable 0-60 seconds), a manual restart will be required. Provide Bidirectional Autospeed Search capable of starting the ASD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

p. The ASD must include external fault reset capability. All the necessary logic to accept an external fault reset contact must be included.

q. Provide critical speed lockout circuitry to prevent operating at frequencies with critical harmonics that cause resonant vibrations. The ASD must have a minimum of three user selectable bandwidths.

r. Provide preperly sized NEMA rated by-pass and isolation contactors to enable operation of motor in the event of ASD failure and for safety transfers motor between power converter output and bypass circuit using a field-selectable automatic and manual bypass mode. Install mechanical and electrical interlocks between the by-pass and isolation contactors. Provide a selector switch and transfer delay timer. Motor overload and short circuit protective features must remain in use during the bypass mode.

s. Each individual ASD must meet the following Total Harmonic Distortion (THD) requirements at the input terminals to the factory assembly of the ASD or at the load disconnecting means serving the ASD and filter assembly. These measurements should be taken with the drive set at 90 percent frequency (rpms) and the motor under a minimum of 50 percent demand.

(1) The Voltage THD should not exceed 2.0 percent THD.

(2) The Current THD should not exceed 15.0 percent THD.

(3) If the standard factory ASD does not meet or exceed these requirements the factory must install appropriate equipment (Harmonic Traps, Filters, different Drive technology, etc.) to mitigate the distortion to assure performance of the VFD is within the limits.

(4) These tests should be performed at the Manufacturers Laboratory facilities and submitted as part of the Product Data Submittals, in order to prevent the necessity of adding mitigation equipment in the field. If the requirements listed above are met, IEEE 519 will also be met.

t. Minimum Operating Conditions. Designed and constructed ASD's to operate within the following service conditions:

(1) Ambient Temperature Rating: 0 to 120 degrees F.

(2) Non-condensing relative humidity rating: less than 95 percent.

(3) Ambient rating: Not exceed 3,300 feet.

2.1.1 ASD for HVAC Application

ASDs must have the following features:

a. A local operator control providing the following functions:

(1) Remote/Local operator selection with password access.

(2) Run/Stop and manual speed commands.

(3) All programming functions.

(4) Scrolling through all display functions.

b. A local operator control panel with the following data displayed:

(1) ASD status.

(2) Frequency.

(3) Motor RPM.

(4) Phase current.

(5) Scrolling through all display functions.

(6) Fault diagnostics in descriptive text.

(7) All programmed parameters.

c. Standard PI loop controller with input terminal for controlled variable and parameter settings.

d. User interface terminals for remote control of ASD speed, speed feedback, and an isolated form C SPDT relay, which energizes on a drive fault condition.

e. An isolated form C SPDT auxiliary relay which energizes on a run command.

f. An adjustable carrier frequency with 16 KHz minimum upper limit.

g. A built-in or external line reactor with 3 percent minimum impedance to protect the DC bus capacitors and rectifier section diodes, reduce power line transient voltage, line notching, DC bus over-voltage tripping and improve the inverter over-current and over-voltage conditions.

h. Historical logging information and displays:

(1) Real-time clock with current time and date.

(2) Running log of total power versus time.

(3) Total run time.

(4) Fault log, maintaining last four faults with time and data stamp for each.

i. The ASD must be capable of automatic control by a remote 0 to 10 VDC signal, by DDC network command, or manually by the ASD control panel.

j. ASDs must include the following operator programmable parameters:

(1) Upper and lower limit frequency.

(2) Acceleration and deceleration rate.

(3) Variable torque volts per Hertz curve.

(4) Starting voltage level.

(5) Starting frequency level.

(6) Display speed scaling.

(7) Enable/disable soft stall feature.

(8) Motor overload level.

(9) Motor stall level.

(10) Jump frequency and hysteresis band.

(11) PWM carrier frequency.

k. ASD must have the following protective features:

(1) An electronic adjustable inverse time current limit with consideration for additional heating of the motor at frequencies below 45Hz, for the protection of the motor.

(2) An electronic adjustable soft stall feature, allowing the ASD to lower the frequency to a point where the motor will not exceed the full-load amperage when an overload ASD will automatically return to the requested frequency when load conditions permit.

(3) A separate electronic stall at 110 percent ASD rated current, and a separate hardware trip at 190 percent current.

(4) The ability to shut down if inadvertently started into a rotating load without damaging the ASD or the motor.

(5) The ability to keep a log of a minimum of four previous fault conditions, indicating the fault type and time of occurrence in descriptive text.

(6) The ability to sustain 110 percent rated current for 60 seconds.

(7) The ability to shutdown safely or protect against and record the following fault conditions:

(a) Over current (and an indication if the over current was during acceleration, deceleration, or running).

(b) Over current internal to the drive.

(c) Motor overload at start-up.

(d) Over voltage from utility power.

(e) Motor running overload.

(f) Over voltage during deceleration.

(g) ASD over heat.

(h) Load and ground fault.

(h) Abnormal parameters or data in ASD EEPROM.

2.2 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 7, and NEMA ICS 6, with a heater if located outdoors. An HMCP device shall provide the disconnecting means. The operating handle shall protrude through the door, but the disconnect shall not be mounted on the door. The handle shall indicate ON, OFF, and tripped conditions. The handle shall have provisions to accommodate a minimum of three padlocks in the OFF position. Interlocks shall prevent unauthorized opening or closing of the ASD door with the disconnect handle in the ON position. The door handle interlock should have provisions to be defeated by qualified maintenance personnel.

2.3 WIRES AND CABLES

All wires and cables must conform to NEMA 250, NEMA ICS 7, NFPA 70.

2.4 NAMEPLATES

Nameplates external to NEMA enclosures must conform with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manufacturer's standard, permanent nameplates for internal areas of enclosures.

2.5 SOURCE QUALITY CONTROL

2.5.1 ASD Test Plan

To ensure quality, each ASD must be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test plans.

2.5.2 ASD Test Report

To ensure quality, each ASD must be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test reports.

PART 3 EXECUTION

3.1 INSTALLATION

Per NEMA ICS 3.1, install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop drawings. A field representative of the drive manufacturer must supervise the installation of all equipment, and wiring.

3.2 GROUNDING

Per NEMA ICS 7.2, ASD must be solidly grounded to the main distribution.

3.3 FIELD QUALITY CONTROL

Specified products must be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. Submit a signed copy of the test results, certifying proper system operation before scheduling tests.

3.3.1 ASD Test

A proposed test plan must be submitted to the contracting officer at least 28 calendar days prior to proposed testing for approval. The tests must conform to NEMA ICS 1, NEMA ICS 7, and all manufacturer's safety regulations. The Government reserves the right to witness all tests and review any documentation. Inform the Government at least 14 working days prior to the dates of testing. Perform the ASD test engaging a qualified testing agency's field supervisor currently certified by NETA to supervise on-site testing.

3.3.2 Performance Verification Tests

"Performance Verification Test" plan must provide the step by step procedure required to establish formal verification of the performance of the ASD. Compliance with the specification requirements must be verified by inspections, review of critical data, demonstrations, and tests. The Government reserves the right to witness all tests, review data, and request other such additional inspections and repeat tests as necessary to ensure that the system and provided services conform to the stated requirements. Inform the Government 14 calendar days prior to the date the test is to be conducted.

3.3.3 Endurance Test

Immediately upon completion of the performance verification test, the endurance test must commence. The system must be operated at varying rates for not less than 192 consecutive hours, at an average effectiveness level of 0.9998, to demonstrate proper functioning of the complete PCS. Continue the test on a day-to-day basis until performance standard is met. The contractor is not allowed in the building during the endurance test. The system must respond as designed.

3.4 DEMONSTRATION

3.4.1 Training

Coordinate training requirements with the Contracting Officer. Provide video tapes, if available, of all training provided to the Government for subsequent use in training new personnel. Provide all training aids, texts, and expendable support material for a self-sufficient presentation shall be provided, the amount of which to be determined by the contracting officer.

3.4.1.1 Instructions to Government Personnel

Provide the services of competent instructors with minimum two-year field experience with the operation and maintenance of similar ASDs who will give full instruction to designated personnel in operation, maintenance, calibration, configuration, and programming of the complete control system. Orient the training specifically to the system installed. Instructors must be thoroughly familiar with the subject matter they are to teach. The number of training days of instruction furnished must be as specified. A training day is defined as eight hours of instruction, including two 15-minute breaks and excluding lunch time; Monday through Friday. Provide a training manual for each student at each training phase which describes in detail the material included in each training program. Provide one additional copy for archiving. Provide equipment and materials required for classroom training. Provide a list of additional related courses, and offers, noting any courses recommended. List each training course individually by name, including duration, approximate cost per person, and location of course. Unused copies of training manuals must be turned over to the Government at the end of last training session.

3.4.1.2 Operating Personnel Training Program

Provide one 2-hour training session at the site at a time and place mutually agreeable between the Contractor and the Government. Provide session to train 4 operation personnel in the functional operations of the system and the procedures that personnel will follow in system operation. This training shall include:

a. System overview

b. General theory of operation

c. System operation

d. Alarm formats

e. Failure recovery procedures

f. Troubleshooting

3.4.1.3 Engineering/Maintenance Personnel Training

Accomplish the training program as specified. Training must be conducted on site at a location designated by the Government. Provide a one-day training session to train four engineering personnel in the functional operations of the system. This training must include:

a. System overview

b. General theory of operation

c. System operation

d. System configuration

e. Alarm formats

f. Failure recovery procedures

g. Troubleshooting and repair

h. Maintenance and calibration

i. System programming and configuration

-- End of Section --

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SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM
08/23

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code
NFPA 780	(2023) Standard for the Installation of Lightning Protection Systems

U.S. AIR FORCE (USAF)

DAFMAN 32-1065	(2020) Grounding and Electrical Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-575-01	(2012; with Change 1, 2021) Lightning and Static Electricity Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 96	(2016; May 2023) UL Standard for Safety Lightning Protection Components
UL 96A	(2016; Reprint Oct 2022) UL Standard for Safety Installation Requirements for Lightning Protection Systems
UL 1449	(2021; Reprint Dec 2022) UL Standard for Safety Surge Protective Devices
UL Electrical Construction	(2012) Electrical Construction Equipment Directory

1.2 RELATED REQUIREMENTS

1.2.1 Verification of Dimensions

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer after engineering approval and before making any departures from the design.

1.2.2 System Requirements

Provide a system furnished under this specification consisting of the latest products of a manufacturer regularly engaged in production of lightning protection system components. Products must be UL listed for use on lightning protection systems unless this rating does not exist for items in question.

Comply with NFPA 70, NFPA 780, UL 96, and UFC 3-575-01.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Lightning Protection and Grounding System Test Plan; G

Grounding Systems Testing; G

SD-07 Certificates

Component UL Listed and Labeled; G

Lightning Protection System Inspection Certificate; G

Roof Manufacturer's Warranty; G

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" or "must" has been substituted for "should," wherever it appears. Interpret references that require LPS expertise in these standards to mean Base Civil Engineer (BCE) or BCE-designated representative with LPS training certification.

1.4.1 Component UL Listed and Labeled

Submit proof of compliance that components are UL Listed and Labeled for use on lightning protection systems. Listing alone in UL Electrical Construction, which is the UL Electrical Construction Directory, is not acceptable evidence. In lieu of Listed and Labeled, submit written certificate from an approved, nationally-recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories (UL).

1.4.2 Lightning Protection and Grounding System Test Plan

Provide lightning protection system and grounding system test plans in compliance with NFPA 780 and DAFMAN 32-1065 chapters 8 and 10, and Attachment 7. As a minimum, include a sketch of the facility and surrounding lightning protection system as part of the specific test plan for each structure. Include the requirements as "Testing of Integral

Lightning Protection System" in the test plan. For explosives facilities, the rolling sphere must be superimposed in elevation drawings, on all three of these types of lightning protection systems for installations with a high strike density as indicated in the NOAA Strike Density Maps. This may be accomplished by Computer Aided Design (CAD). Integral systems are discouraged on explosives and communications facilities because it has the potential to bring lightning closer to what is being protected. For explosives facilities, record drawings with materials description (wire size, air terminal material, etc.) is required by the base Weapons Safety Office. Testing of Surge Protective Devices must comply with UL 1449 and annual inspection of Surge Protective Devices should be included on Figures A7.6 and A7.7.

1.4.3 Lightning Protection System Inspection Certificate of Qualifications

Provide an approved third-party inspector who meets training certification requirements for final acceptance of the LPS. Inspection and certification of the LPS must be completed and certified in writing, before occupancy of the building. Compliance requirements are in UFC 3-575-01 and DAFMAN 32-1065, paragraphs 4.2 and 4.3. Signed Certificate of Qualifications must be placed in the LPS records.

Note that the Contracting Officer may not accept the LPS system without a recommendation from a qualified person identified in the project documents.

1.5 SITE CONDITIONS

Confirm all details of work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before starting any work, if known at that time, or when it becomes known while performing work. Obtain prior approval of the BCE or BCE-designated representative with LPS training certification before design changes are made.

PART 2 PRODUCTS

2.1 MATERIALS

See NFPA 70, NFPA 780, UFC 3-575-01, DAFMAN 32-1065. Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings, such as tin or lead, or oversize conductors. Where a mechanical hazard is involved, increase conductor size to compensate for the hazard or protect conductors. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic). All lightning protection components, such as bonding plates, air terminals, air terminal supports and braces, chimney bands, clips, connector fittings, and fasteners are to comply with the requirements of UL 96 classes, as applicable.

2.1.1 Main and Bonding Conductors

Main and Bonding Conductors should be NFPA 780 and UL 96 Class I or Class II materials, as applicable. For explosives, Class II materials are in accordance with NFPA 780, Chapter 8.

2.1.2 Conductors

Provide copper or aluminum conductors, as applicable. See NFPA 780, UFC 3-575-01, DAFMAN 32-1065.

2.2 COMPONENTS

2.2.1 Air Terminals on Integral Systems

Provide solid air terminals. Tubular air terminals are not permitted. Support air terminals more than 24 inches in length by suitable brace, supported at not less than one-half the height of the terminal.

2.2.2 Ground Rods

Provide ground rods conforming to NFPA 780. Provide ground rods that are not less than 5/8 inch in diameter and 8 feet in length. Do not mix ground rods of copper-clad steel and solid copper on the job.

2.2.3 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by compression clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.4 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780 and UL 96.

PART 3 EXECUTION

3.1 LIGHTNING PROTECTION SYSTEMS

Provide a lightning protection system that meets the requirements of NFPA 780 and UFC 3-575-01.

3.1.1 Integral Lightning Protection System

The integral type lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, grounding electrodes and ground ring electrode conductor for the purpose of carrying lightning current from a direct strike to ground in a manner that will protect assets and personnel. Expose all conductors on the structures except where exterior down conductors are required to be in protective sleeves for prevention of mechanical damage (6 feet above grade level). Integral systems are the least preferred, especially for explosives and communications facilities. When use of integral systems is determined by the designer or site conditions to be necessary, do not run down conductors inside columns or other methods which will prevent visual access for required inspections. Visual access is required by NFPA 780 and DAFMAN 32-1065 so that the annual visual inspection may be performed on all LPS components.

Make interconnections within side-flash distances between down conductors and metallic equipment mounted on the exterior or interior of a facility, at or below the level of the grounded metallic parts. Calculate side-flash distances in accordance with NFPA 780. Be aware of side flashes that may occur through exterior walls.

Note that integral systems should be avoided as LPS for Explosives and Communications facilities and is discouraged for general facilities. Installation and maintenance costs of an integral system are excessive and this method is maintenance intensive. The complexity and number of test points dictates frequent interruption to missions and daily operations for required annual inspections and testing. Integral systems require fall protection and maintenance of that fall protection system. For fall protection, maintain NFPA 780-compliant separation distance between the integral system and metallic fall protection.

3.1.1.1 Roof-Mounted Components

Coordinate with the roofing manufacturer and provide certification that the roof manufacturer's warranty is not violated by the installation methods for air terminals and roof conductors. Adhesive fasteners may be used on the roof if the installation is observed by base-qualified personnel to be compliant with manufacturer's instructions. Installation must be observed until the observer is satisfied that the proper methods for preparing the surface are being performed. These fasteners will be added and considered a test point in Base records and must be part of the annual inspection. Observer must date and sign the test record.

No connection or physical attachment is allowed to any coping system on the roof as this violates the integrity and warranty of the coping system.

3.1.1.2 Air Terminals

Use of adhesive fasteners, when installing air terminals on "rubber" (EPDM) type roofs, should be in accordance with adhesive and roof manufactures' recommendations. See paragraph ROOF-MOUNTED COMPONENTS.

3.1.1.3 Roof Conductors

Roof conductors should comply with NFPA 780 and DAFMAN 32-1065.

3.1.2 Down Conductors

A minimum of two paths to ground shall be provided on any system. This may be by two down conductors or with a down conductor in combination with other metallic connections to ground. Protect exposed down conductors from physical damage from ground level up to 6 feet. If this protection is a metal conduit, both ends must be bonded to the down conductor passing through it. For Schedule 80 conduit providing this protection, no bonding at both ends is necessary. Schedule 80 conduit or metallic conduit may be painted to match the surrounding surface. NO CONNECTIONS OR FASTENERS OF ANY LIGHTNING PROTECTION SYSTEM MAY BE PAINTED because this affects the ease with which lightning current can pass to ground.

3.1.3 Ground Connections

Attach each down conductor and ground ring electrode to a ground rod below grade by exothermic weld for all buried connections and exothermic weld or compression connectors for connections inside test wells. Terminate all down conductors to a grounding electrode inside a test well. Test connections and record resistances and continuity readings prior to covering.

Accessible connections above ground level and in test wells can be grounded with mechanical clamping, meeting installation requirements in NFPA 780.

3.1.4 Installation of Grounding Electrodes (Ground Rods)

Extend driven ground rods vertically into the existing undisturbed earth for a distance of not-less-than 8 feet if exothermic welds are used for bonds. Inside test wells, the 5/8 in. by 8 ft rod may be driven to a point above the base of the test well, that will provide working/testing access to the mechanically-fastened bond. Set ground rods not less than 3 feet nor more than 6 feet (see NFPA 780) from the structural foundation, and at least 3 feet beyond the drip line for the facility. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE 81. Maximum allowed resistance of a single driven ground rod is 25 ohms (NFPA 70). If resistance-to-ground of a single ground rod for the lightning protection system exceeds 25 ohms and another ground rod is driven in accordance with NFPA 780, 25 ohms does not apply to this test point. See NFPA 70 exception to Article 250.53.

3.2 APPLICATIONS

3.2.1 Personnel Ramps and Covered Passageways

Lightning Protection is required in accordance with NFPA 780 and UFC 3-575-01.

3.3 INTERFACE WITH OTHER STRUCTURES

3.4 RESTORATION

Where sod has been removed, replace sod as soon as possible after completing the backfilling. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work, to original condition. Overfill the trench to accommodate for settling. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging or mulching in any restoration, to match existing. Maintain disturbed surfaces and replacements until final acceptance. Return to site after six months to fill in compacted surface.

3.5 FIELD QUALITY CONTROL

3.5.1 Lightning Protection Systems Testing

A 100 percent test point test and inspection is required by all services. Identify test points for lightning protection system connections and bonds. Provide a sketch (NTS) with identified test points as part of the contract acceptance. Number points in a manner consistent with the installation (Base or Post) nomenclature for existing lightning protection systems; for example, use letters or numbers to track the test results. Test each lightning protection system connection to ensure continuity across each connection or bond is 1 ohm or less, and record the value indicated on a copy of the test form located at the back of DAFMAN 32-1065, Attachment 7.

a. LPS testing must also be accomplished on smaller projects, such as roofing and HVAC projects, where lightning protection systems are installed on any facility with existing LPS, to ensure the LPS is not damaged or reconfigured during construction.

b. Comply with UL 96A. A third-party inspector (not the designer and not the installer) must be present for the 100 percent inspection and data documentation by the contractor. This is to take place prior to project acceptance. Note that in many cases Air Force personnel have been trained to inspect and accept projects as the third-party inspector. Verify this before contract award.

3.5.2 Grounding Systems Testing

A 100 percent test point resistance test and inspection is required. Identify all test points for grounding system connections and bonds. Provide a sketch (NTS) with identified test points as part of the contract acceptance. Number points in a manner consistent with the installation (Base or Post) nomenclature for existing grounding systems; for example, use letters or numbers to track the test results. Test each grounding system connection or bond to ensure resistance-to-ground is 25 ohms or less or as excepted by NFPA 70 or NFPA 780. Record the resistance measurement on a copy of the test form located at the back of DAFMAN 32-1065 for Air Force or a similar form provided by the Army or Navy. Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, and not earlier than 48 hours after rainfall. Include in the written report: locations of test points, measured values for continuity and ground resistances, and soil conditions at the time that measurements were made. Submit results of each test to the Contracting Officer.

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SECTION 26 51 00

INTERIOR LIGHTING
05/20, CHG 2: 11/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A580/A580M	(2023) Standard Specification for Stainless Steel Wire
ASTM A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1008/A1008M	(2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM B164	(2003; R 2014) Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B633	(2023) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM D4674 REV A	(2002; R 2010) Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments

EUROPEAN UNION (EU)

Directive 2011/65/EU	(2011) Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment

ILLUMINATING ENGINEERING SOCIETY (IES)

ANSI/IES LM-79	(2019) Approved Method: Electrical and Photometric Measurements of Solid State Lighting Products
ANSI/IES LM-80	(2020) Approved Method: Measuring Luminous Flux and Color Maintenance of LED

	Packages, Arrays and Modules
ANSI/IES LS-1	(2020) Lighting Science: Nomenclature and Definitions for Illuminating Engineering
ANSI/IES TM-15	(2020) Technical Memorandum: Luminaire Classification System for Outdoor Luminaires
ANSI/IES TM-21	(2021) Technical Memorandum: Projecting Long-TermLuminous, Photon, and Radiant Flux Maintenance of LED Light Sources
ANSI/IES TM-30	(2020) Technical Memorandum: IES Method for Evaluating Light Source Color Rendition
IES Lighting Library	IES Lighting Library

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2023) National Electrical Safety Code
IEEE C62.41	(1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 77	(2017) Temporal Light Artifacts: Test Methods and Guidance for Acceptance Criteria
NEMA ANSLG C78.377	(2017) Electric Lamps— Specifications for the Chromaticity of Solid State Lighting Products
NEMA C82.77-10	(2020) Harmonic Emission Limits - Related Power Quality Requirements
NEMA SSL 1	(2016) Electronic Drivers for LED Devices, Arrays, or Systems
NEMA SSL 3	(2011) High-Power White LED Binning for General Illumination
NEMA SSL 7A	(2015) Phase-Cut Dimming for Solid State Lighting: Basic Compatibility
NEMA WD 1	(1999; R 2020) Standard for General Color Requirements for Wiring Devices
NEMA WD 7	(2011; R 2016; R 2021) Occupancy Motion Sensors Standard

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code
NFPA 101	(2021; TIA 21-1) Life Safety Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 20	(2018; Reprint May 2023) UL Standard for Safety General-Use Snap Switches
UL 94	(2023; Reprint May 2023) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 508	(2018; Reprint Jul 2021) UL Standard for Safety Industrial Control Equipment
UL 844	(2012; Reprint Oct 2021) UL Standard for Safety Luminaires for Use in Hazardous (Classified) Locations
UL 916	(2015; Reprint Oct 2021) UL Standard for Safety Energy Management Equipment
UL 924	(2016; Reprint Dec 2022) UL Standard for Safety Emergency Lighting and Power Equipment
UL 1472	(2015) UL Standard for Safety Solid-State Dimming Controls
UL 1598	(2021; Reprint Jun 2021) Luminaires
UL 1598C	(2014) Standard for Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits
UL 2043	(2023) Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
UL 8750	(2015; Reprint Sep 2021) UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.2 RELATED REQUIREMENTS

Materials not considered to be luminaires, luminaire accessories, or lighting equipment are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Luminaires and accessories that are mounted in exterior environments and not attached to the exterior of the building are specified in Section 26 56 00 EXTERIOR LIGHTING. Commissioning requirements are specified in Section 01 91 00.15 BUILDING COMMISSIONING.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications and on the drawings, must be as defined in IEEE 100 and ANSI/IES LS-1.

b. For LED luminaire light sources, "Useful Life" is the operating hours before reaching 70 percent of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions. This is also known as 70 percent "Rated Lumen Maintenance Life" as defined in ANSI/IES LM-80.

c. For LED luminaires, "Luminaire Efficacy" (LE) is the appropriate measure of energy efficiency, measured in lumens/watt. This is gathered from LM-79 data for the luminaire, in which absolute photometry is used to measure the lumen output of the luminaire as one entity, not the source separately and then the source and housing together.

d. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Luminaire Drawings; G

Occupancy/Vacancy Sensor Coverage Layout; G; S

Lighting Control System One-Line Diagram; G

Sequence of Operation for Lighting Control System; G

SD-03 Product Data

Luminaires; G

Light Sources; G

LED Drivers; G

Luminaire Warranty; G

Lighting Controls Warranty; G

Switches; G

Wall Box Dimmers; G

Scene Wallstations; G

Occupancy/Vacancy Sensors; G

Power Packs; G

Exit Signs; G

Emergency Drivers; G

SD-05 Design Data

Luminaire Design Data; G

Photometric Plan; G

SD-06 Test Reports

ANSI/IES LM-79 Test Report; G

ANSI/IES LM-80 Test Report; G

ANSI/IES TM-21 Test Report; G

ANSI/IES TM-30 Test Report; G

Occupancy/Vacancy Sensor Verification Test; G

SD-07 Certificates

LED Driver and Dimming Switch Compatibility Certificate; G

SD-10 Operation and Maintenance Data

Lighting System, Data Package 5; G

Lighting Control System, Data Package 5; G

Maintenance Staff Training Plan; G

End-User Training Plan; G

1.5 QUALITY ASSURANCE

Data, drawings, and reports must employ the terminology, classifications and methods prescribed by the IES Lighting Library as applicable, for the lighting system specified.

1.5.1 Luminaire Drawings

Include dimensions, accessories installation details, and construction details. Photometric data, including CRI, CCT, LED driver type, zonal lumen data, and candlepower distribution data must accompany shop drawings.

1.5.2 Luminaire Design Data

a. Provide safety certification and file number for the luminaire family that must be listed, labeled, or identified in accordance with the NFPA 70. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian

Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratories).

b. Provide long term lumen maintenance projections for each LED luminaire in accordance with ANSI/IES TM-21. Data used for projections must be obtained from testing in accordance with ANSI/IES LM-80.

1.5.3 ANSI/IES LM-79 Test Report

Submit test report on manufacturer's standard production model of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data in IES format as outlined under "14.0 Test Report" in ANSI/IES LM-79.

1.5.4 ANSI/IES LM-80 Test Report

Submit report on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data as outlined under "8.0 Test Report" in ANSI/IES LM-80.

1.5.5 ANSI/IES TM-21 Test Report

Submit test report on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data, as well as required interpolation information as outlined under "7.0 Report" in ANSI/IES TM-21.

1.5.6 ANSI/IES TM-30 Test Report

Submit color vector graphic in accordance with ANSI/IES TM-30 on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Include spectral distribution of test LED light source.

1.5.7 LED Driver and Dimming Switch Compatibility Certificate

Submit certification from the luminaire, driver, or dimmer switch manufacturer that ensures compatibility and operability between devices without flickering and to specified dimming levels.

1.5.8 Photometric Plan

1.5.8.1 Computer-generated Photometric Plans

Computer-generated photometric plans for each space are required to verify proposed luminaires and locations meet the required performance criteria of the design using the applicable light loss factor (LLF).

Target illumination levels are provided for each Interior Application. Depending on the application and the recommendations provided by the IES, values are given as one of the following:

a. Minimum: No values anywhere on the calculation grid may be less than this value, within a 10 percent margin of error.

b. Minimum Average: An average, taken over the entire task area for the application, may not be less than this value, within a 10 percent margin of error.

c. Maximum: No values anywhere on the calculation grid may be greater than this value, within a 10 percent margin of error.

d. Maximum Average: An average, taken over the entire task area for the application, may not be greater than this value, within a 10 percent margin of error.

e. Uniformity: Unless otherwise noted, uniformity is calculated as a ratio of the average calculated illuminance over the minimum calculated illuminance of the calculation grid.

1.5.8.2 Schematic Photometric Plan Calculations

Schematic photometric plan calculations must include:

a. Horizontal illuminance measurements at workplane or other designated height above finished floor, taken at a maximum of every one foot across the task area.

b. Average maintained illuminance level.

c. Minimum and maximum maintained illuminance levels.

d. Lighting power density (Watts per square foot).

e. LLF. Recommended LLF is 0.81 for LED luminaires but LLF varies based on environment and application.

1.5.8.3 Final Photometric Plan Calculations

Final photometric plan calculations must include:

a. Horizontal illuminance measurements at workplane or other designated height above finished floor, taken at a maximum of every one foot across the task area.

b. Where applicable, vertical illuminance measurements at designated surface, taken at a maximum of every one foot across task area.

c. Minimum and maximum maintained illuminance levels.

d. Average maintained illuminance level.

e. Average to minimum and maximum to minimum ratios for horizontal illuminance.

f. Lighting power density (Watts per square foot).

g. LLF. Recommended LLF is 0.81 for LED luminaires but LLF varies based on environment and application.

1.5.9 Occupancy/Vacancy Sensor Coverage Layout

Provide floor plans showing coverage layouts of all devices using manufacturer's product information.

1.5.10 Test Laboratories

Test laboratories for the ANSI/IES LM-79 and ANSI/IES LM-80 test reports must be one of the following:

a. National Voluntary Laboratory Accreditation Program (NVLAP) accredited for solid-state lighting testing as part of the Energy-Efficient Lighting Products laboratory accreditation program for both LM-79 and LM-80 testing.

b. One of the qualified labs listed on the Department of Energy - LED Lighting Facts Approved Testing Laboratories List for LM-79 testing.

c. One of the EPA-Recognized Laboratories listed for LM-80 testing.

1.5.11 Regulatory Requirements

Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70, unless more stringent requirements are specified or indicated. Provide luminaires and assembled components that are approved by and bear the label of UL for the applicable location and conditions unless otherwise specified.

1.5.12 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products must have been in satisfactory commercial or industrial use for six months prior to bid opening. The six-month period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the six-month period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.12.1 Alternative Qualifications

Products having less than a six-month field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.12.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than six months prior to date of delivery to site, unless specified otherwise.

1.6 WARRANTY

Support all equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.1 Luminaire Warranty

Provide and transfer to the government the original LED luminaire manufacturers standard commercial warranty for each different luminaire manufacturer used in the project.

a. Provide a written five year minimum replacement warranty for material, luminaire finish, and workmanship. Provide written warranty document that contains all warranty processing information needed, including customer service point of contact, whether or not a return authorization number is required, return shipping information, and closest return location to the luminaire location.

(1) Finish warranty must include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

(2) Material warranty must include:

(a) All LED drivers and integral control equipment.

(b) Replacement when more than 15 percent of LED sources in any lightbar or subassembly(s) are defective, non-starting, or operating below 70 percent of specified lumen output.

b. Warranty period must begin in accordance with the manufacturer's standard warranty starting date.

c. Provide replacements that are promptly shipped, without charge, to the using Government facility point of contact and that are identical to or an improvement upon the original equipment. All replacements must include testing of new components and assembly.

1.6.2 Lighting Controls Warranty

Provide and transfer to the government the original lighting controls manufacturers standard commercial warranty for each different lighting controls manufacturer used in the project. Warranty coverage must begin from date of final system commissioning or three months from date of delivery, whichever is the earliest. Warranty service must be performed by a factory-trained engineer or technician.

a. Unless otherwise noted, provide a written five year minimum warranty on the complete system for all systems with factory commissioning. Provide warranty that covers 100 percent of the cost of any replacement parts and services required over the five years which are directly attributable to the product failure. Failures include, but are not limited to, the following:

(1) Software: Failure of input/output to execute switching or dimming commands.

(2) Damage of electronic components due to transient voltage surges.

(3) Failure of control devices, including but not limited to occupancy sensors, photosensors, and manual wall station control devices.

b. Provide a written five year minimum warranty on all input devices against defect in workmanship or materials provided by device manufacturer.

c. Provide a written five year minimum warranty on all control components attached to luminaires against defect in workmanship or materials.

1.7 OPERATION AND MAINTENANCE MANUALS

1.7.1 Lighting System

Provide operation and maintenance manuals for the lighting system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the lighting system for the building. Include the following:

a. Manufacturers' operating and maintenance manuals.

b. Luminaire shop drawings for modified and custom luminaires.

c. Luminaire Manufacturers' standard commercial warranty information as specified in paragraph LUMINAIRE WARRANTY.

1.7.2 Lighting Control System

Provide operation and maintenance manuals for the lighting control system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the lighting control system for the building. Include the following:

a. Lighting control system layout and wiring plan.

b. Lighting control system one-line diagram.

c. Product data for all devices, including installation and programming instructions.

d. Occupancy/vacancy sensor coverage layout.

e. Training materials, such as videos or in-depth manuals, that cover basic operation of the lighting control system and instructions on modifying the lighting control system. Training materials must include calibration, adjustment, troubleshooting, maintenance, repair, and replacement.

f. Sequence of operation descriptions for each typical room type, including final programming, schedules, and calibration settings.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

2.2 LUMINAIRES

UL 1598, NEMA C82.77-10. Provide luminaires as indicated in the luminaire schedule and NL plates or details on project plans, complete with light source, wattage, and lumen output indicated. All luminaires of the same type must be provided by the same manufacturer. Luminaires must be specifically designed for use with the driver and light source provided.

2.2.1 Luminaires

UL 8750, ANSI/IES LM-79, ANSI/IES LM-80. For all luminaires, provide:

a. Complete system with LED drivers and light sources.

b. Housings constructed of non-corrosive materials. All new aluminum housings must be anodized or powder-coated. All new steel housings must be treated to be corrosion resistant.

c. ANSI/IES TM-21, ANSI/IES LM-80. Minimum L70 lumen maintenance value of 50,000 hours unless otherwise indicated in the luminaire schedule. Luminaire drive current value must be identical to that provided by test data for luminaire in question.

d. Minimum efficacy as specified in the luminaire schedule. Theoretical models of initial lamp lumens per watt are not acceptable. If efficacy values are not listed in the luminaire schedule, provide luminaires that meet the following minimum values:

Luminaire Style	Minimum Luminaire Efficacy
Recessed 1 by 4, 2 by 4, and 2 by 2	100 LPW
Recessed Downlight (fixed, adjustable, wallwash)	80 LPW
Linear, Accent (undercabinet, cove)	45 LPW
Linear, Ambient (indirect wall mount, linear pendent)	100 LPW
Exterior Wall Sconce	50 LPW

e. UL listed for dry or damp location typical of interior installations. Any luminaire mounted on the exterior of the building must be UL listed for wet location typical of exterior installations.

f. LED driver and light source package, array, or module are accessible for service or replacement without removal or destruction of luminaire.

g. Lenses constructed of heat tempered borosilicate glass, UV-resistant acrylic, or silicone. Sandblasting, etching and polishing must be performed as indicated in the luminaire description.

h. ANSI/IES TM-15. Provide exterior building-mounted luminaires that do not exceed the BUG ratings as listed in the luminaire schedule. If BUG ratings are not listed in the luminaire schedule, provide luminaires that meet the following minimum values for each application and mounting conditions:

Lighting Application	Mounting Conditions	BUG Rating
Exterior Wall Sconce	Above 4 feet AFF	B1-U0-G2

2.2.1.1 Luminaire Conversion Kits

Provide luminaire conversion kits that meet UL 1598C Standard for Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits.

2.2.2 Luminaires for Hazardous Locations

In addition to requirements stated herein, provide LED luminaires for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated.

2.3 LIGHT SOURCES

NEMA ANSLG C78.377, NEMA SSL 3. Provide type, delivered lumen output, and wattage as indicated in the luminaire schedule on project plans.

2.3.1 LED Light Sources

Provide LED light sources that meet the following requirements:

a. NEMA ANSLG C78.377. Emit white light and have a nominal CCT of 3500 Kelvin.

b. Minimum Color Rendering Index (CRI) of 80.

c. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

d. Light source color consistency by utilizing a binning tolerance within a 3-step McAdam ellipse.

2.4 LED DRIVERS

NEMA SSL 1, UL 8750. Provide LED drivers that are electronic, UL Class 1 or Class 2, constant-current type and that comply with the following requirements:

a. The combined driver and LED light source system does not exceed the minimum luminaire efficacy values as listed in the luminaire schedule provided.

b. Operates at a voltage of 120-277 volts at 50/60 hertz, with input voltage fluctuations of plus/minus 10 percent.

c. Power Factor (PF) greater than or equal to 0.90 at full input power and across specified dimming range.

d. Maximum Total Harmonic Distortion (THD) less than 20 percent at full input power and across specified dimming range.

e. Operates for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.

f. Withstands Category A surges of 2 kV without impairment of performance. Provide surge protection that is integral to the driver.

g. Integral thermal protection that reduces the output power to protect the driver and light source from damage if the case temperature approaches or exceeds the driver's maximum operating temperature.

h. 47 CFR 15. Complies with the requirements of the Federal Communications Commission (FCC) rules and regulations, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

i. Class A sound rating.

j. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

k. Provide dimming capability as indicated in the luminaire schedule on project plans. Dimmable drivers must dim down to 10 percent. Dimmable drivers must be controlled by a Class 2 low voltage 0-10VDC controller dimming signal protocol unless otherwise specified. LED drivers of the same family/series must track evenly across multiple luminaires at all light levels.

2.5 LIGHTING CONTROLS

Provide network certification for all networked lighting control systems and devices in accordance with the requirements of Section 25 05 11. CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS. Provide lighting control systems that do not switch off battery-operated or emergency backup luminaires or exit signs in path of egress. Provide system with override of lighting control devices controlling luminaires in path of egress with activation of fire alarm system.

2.5.1 System

Provide lighting control system that operates the lighting system as described in the lighting control strategies in the project plans. Submit Sequence of Operation for Lighting Control System describing the operation of the proposed lighting control system and devices. Sequence of Operation must provide the strategies identified in the lighting control strategies.

2.5.1.1 Localized Control Systems

Provide room or area-wide lighting control system capable of manual control, time-based control, and receiving input from photosensors and occupancy/vacancy sensors.

2.5.2 Devices

2.5.2.1 Switches

Provide line-voltage toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. When used for non-digital loads, devices must be rated at 20 Amps inductive load, and be compatible with the lighting control systems.

2.5.2.2 Wall Box Dimmers

UL 1472, UL 20, IEEE C62.41, NEMA 77, NEMA SSL 7A. Dimmers must provide flicker-free, continuously variable light output throughout the dimming range of 10 percent to 100 percent. Devices must be capable of operating at their full rated capacity regardless of being single or ganged-mounted, and be compatible with three-way and four-way switching scenarios.

Provide wall-box dimmers that meet the following requirements:

a. Device operates as an independent control device.

b. Device operates with the use of a vertical slider, paddle, rotary, button, or toggle with adjacent vertical slider.

c. Finish of device matches switches and outlets in the same area.

d. Back box in wall has sufficient depth to accommodate body of switch and wiring.

e. Dimmer is capable of controlling 0-10 volt LED drivers. Dimmers and the drivers they control must be provided from the same manufacturer or tested and certified as compatible for use together.

f. Radio frequency interference suppression is integral to device.

2.5.2.3 Scene Wallstations

Provide scene wallstations that are compatible with the other components of the lighting control system and capable of Class 1 or 2 wiring methods in accordance with the NEC and local codes. Provide devices that contain on/off group, preset scene functions, or dim up/dim down interface through front panel. Programming of new scenes or zone assignments must be accomplished by authorized personnel from the space being controlled. Provide labeling for each button, including laminated sheet with scene descriptions to be posted near each scene controller.

2.5.2.4 Occupancy/Vacancy Sensors

IEEE C62.41, NEMA WD 1, UL 94, UL 916, UL 508, ASTM D4674 REV A, NEMA WD 7. Provide occupancy/vacancy sensors with coverage patterns as indicated on manufacturer shop drawings. Provide no less quantity of sensors as shown on plans, but add additional sensors when required to fulfill coverage requirement for the specific model of sensor provided. Provide sensor types as described in the sequence of operations. Sensor locations and quantities are shown in shop drawings provided by the lighting control system manufacturer. Provide occupancy sensor operation that requires movement to activate luminaires controlled and turns luminaires off after a set time of inactivity. Provide vacancy sensor operation that requires manual control to activate luminaires and turns luminaires off after a set time of inactivity. Provide ceiling or wall-mounted occupancy/vacancy sensors that meet the following requirements:

a. Operating voltage of 12-24 volts.

b. Time delay of 30 seconds to 30 minutes with at least four intermediate time delay settings.

c. Sensors are ceiling mounted orwall-box mounted.

d. Does not exceed a maximum load requirement of 20mA at 24VDC.

e. Shielded or controlled by internal logic to adjust sensitivity to avoid false triggering due to ambient temperature, air temperature variations or HVAC air movement.

f. Sensor is equipped to automatically energize the connected load upon loss of normal power when located in a means of egress.

g. Occupancy and vacancy operation is field-adjustable and programmable with push-button or dip switch on the sensor device.

h. No leakage current to load when in the off mode.

i. Utilize zero-crossing circuitry to prevent damage from high inrush current and to promote long life operation.

k. Provide an isolated relay for integrating control of HVAC or other automated systems.

2.5.2.4.1 Passive Infrared Sensors

Provide Passive Infrared Sensors (PIR) sensors that detect occupancy by sensing heat and movement in the area of coverage. Provide sensors are constructed of a housing of high-impact, injection-molded thermoplastic. Provide PIR sensors that are temperature compensated, with a dual element sensor and a multi-element fresnel lens of POLY IR4 material.

2.5.2.4.2 Ultrasonic Sensors

Provide ultrasonic sensors that detect occupancy by sensing a change in pattern of reflected ultrasonic waves in the area of coverage. Provide sensors that are constructed of a housing of high-impact, injection-molded thermoplastic. Provide ultrasonic sensors that operate at 40 kHz.

2.5.2.4.3 Dual Technology Sensors

Provide dual technology sensors that meet the requirements for PIR sensors and ultrasonic sensors indicated above. If either the PIR or ultrasonic sensing registers occupancy, the luminaires must remain on.

2.5.2.4.4 Power Packs

UL 2043. Provide power packs to provide power to lighting control sensors as required in accordance with the manufacturer's specifications. Provide power packs that meet the following requirements:

a. Operate at an input voltage of 120-277 VAC, with an output voltage 12-24 VDC at 225 mA.

b. Constructed of plenum-rated, high-impact thermoplastic enclosure.

c. Utilizes zero-crossing circuitry to prevent damage from inrush current.

d. Maximum load rating of 16 amps for electronic LED lighting loads.

e. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

2.6 EXIT AND EMERGENCY LIGHTING EQUIPMENT

2.6.1 Exit Signs

UL 924, NFPA 101. Provide wattage as indicated in the luminaire schedule on project plans. Provide LED Exit Signs that meet the following criteria:

a. Housing constructed of painted, die-cast aluminum.

b. UL listed for damp location.

c. Configured for universal mounting.

d. 6 inch high, 3/4 inch stroke red lettering on face of sign with chevrons on either side of lettering to indicate direction.

e. Single or double face as indicated in project plans and luminaire schedule.

2.6.1.1 Exit Signs with Battery Backup

Equip with automatic power failure device, test switch, and pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery must be sealed, maintenance free nickel-cadmium type, and must operate unattended for a period of not less than five years. Emergency run time must be a minimum of 1-1/2 hours. LEDs must have a minimum rated life of 10 years. Provide self-diagnostic circuitry integral to emergency LED driver. In lieu of battery, can use a nonradioactive photoluminescent plate.

2.6.1.2 Remote-Powered Exit Signs

Provide exit sign that contains provision for 120-277 VAC input from remote source.

2.6.2 LED Emergency Drivers

UL 924, NFPA 101. Provide LED emergency driver with automatic power failure detection, test switch and LED indicator (or combination switch/indicator) located on luminaire exterior, and fully-automatic solid-state charger, battery and inverter integral to a self-contained housing. Provide self-diagnostic function integral to emergency driver. Integral nickel-cadmium battery is required to supply a minimum of 90 minutes of emergency power at 10 watts, 10-50 VDCcompatible with LED forward voltage requirements, constant output. Driver must be RoHS compliant, rated for installation in plenum-rated spaces and damp locations, and be warranted for a minimum of five years.

2.6.3 Self-Diagnostic Circuitry for LED Drivers

UL 924, NFPA 101. Provide emergency lighting unit with fully-automatic, integral self-testing/diagnostic electronic circuitry. Circuitry must provide for a one minute diagnostic test every 28 days, and a 30 minute diagnostic test every six months, minimum. Any malfunction of the unit must be indicated by LED(s) visible from the exterior of the luminaire. A manual test switch must also be provided to perform a diagnostic test at any given time.

2.7 LUMINAIRE MOUNTING ACCESSORIES

2.7.1 Suspended Luminaires

a. Provide hangers capable of supporting twice the combined weight of luminaires supported by hangers.

b. Hangers must allow luminaires to swing within an angle of 45 degrees. Brace pendents 4 feet or longer to limit swinging. Provide with swivel hangers to ensure a plumb installation for rigid stem pendents. Provide cadmium-plated steel with a swivel-ball tapped for the conduit size indicated.

c. Single-unit suspended luminaires must have cable or twin-stem hangers. Multiple-unit or continuous row luminaires with a separate power supply cord must have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end.

d. Provide all linear pendent and surface mounted luminaires with two supports per four-foot section or three per eight-foot section unless otherwise recommended by manufacturer.

e. Provide rods in minimum 0.18 inch diameter.

2.7.2 Recess and Surface Mounted Luminaires

Provide access to light source and LED driver from bottom of luminaire. Provide trim and lenses for the exposed surface of flush-mounted luminaires as indicated on project drawings and specifications. Luminaires recessed in ceilings which have a fire resistive rating of one hour or more must be enclosed in a box which has a fire resistive rating equal to that of the ceiling. For surface mounted luminaires with brackets, provide flanged metal stem attached to outlet box, with threaded end suitable for supporting the luminaire rigidly in design position. Flanged part of luminaire stud must be of broad base type, secured to outlet box at not fewer than three points.

2.7.3 Luminaire Support Hardware

2.7.3.1 Wire

ASTM A641/A641M. Galvanized, soft tempered steel, minimum 0.11 inches in diameter, or galvanized, braided steel, minimum 0.08 inches in diameter.

2.7.3.2 Wire for Humid Spaces

ASTM A580/A580M. Composition 302 or 304, annealed stainless steel, minimum 0.11 inches in diameter.

ASTM B164. UNS NO4400, annealed nickel-copper alloy, minimum 0.11 inches in diameter.

2.7.3.3 Threaded Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

2.7.3.4 Straps

Galvanized steel, one by 3/16 inch, conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B633, Type RS.

2.8 EQUIPMENT IDENTIFICATION

2.8.1 Manufacturer's Nameplate

Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8.2 Labels

UL 1598. All luminaires must be clearly marked for operation of specific light sources and LED drivers. The labels must be easy to read when standing next to the equipment, and durable to match the life of the equipment to which they are attached. Note the following light source characteristics in the format "Use Only _____":

a. Correlated Color Temperature (CCT) and Color Rendering Index (CRI) for all luminaires.

b. Driver and dimming protocol.

All markings related to light source type must be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when light sources are in place. LED drivers must have clear markings indicating dimming type and indicate proper terminals for the various outputs.

PART 3 EXECUTION

3.1 INSTALLATION

IEEE C2, NFPA 70.

3.1.1 Light Sources

When light sources are not provided as an integral part of the luminaire, deliver light sources of the type, wattage, lumen output, color temperature (CCT), color rendering index (CRI), and voltage rating indicated to the project site and install just prior to project completion, if not already installed in the luminaires from the factory.

3.1.2 Luminaires

Set luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent luminaires and secure in accordance with manufacturers' directions and approved drawings. Provide accessories as required for ceiling construction type indicated on Finish Schedule. Luminaire catalog numbers do not necessarily denote specific mounting accessories for type of ceiling in which a luminaire may be installed. Provide wires, straps, or rods for luminaire support in this section. Install luminaires with vent holes free of air blocking obstacles.

3.1.2.1 Suspended Luminaires

Measure mounting heights from the bottom of the luminaire for ceiling-mounted luminaires and to center of luminaire for wall-mounted luminaires. Obtain architect approval of the exact mounting height on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Support suspended luminaires from structural framework of ceiling or from inserts cast into slab.

a. Provide suspended luminaires with 45 degree swivel hangers so that they hang plumb and level.

b. Locate so that there are no obstructions within the 45 degree range in all directions.

c. The stem, canopy and luminaire must be capable of 45 degree swing.

d. Rigid pendent stem, aircraft cable, rods, or chains 4 feet or longer excluding luminaire must be braced to prevent swaying using three cables at 120 degree separation.

e. Suspended luminaires in continuous rows must have internal wireway systems for end to end wiring and must be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces.

f. Utilize aligning splines on extruded aluminum luminaires to assure minimal hairline joints.

g. Support steel luminaires to prevent "oil-canning" effects.

h. Match supporting pendents with supported luminaire. Aircraft cable must be stainless steel.

i. Match finish of canopies to match the ceiling, and provide low profile canopies unless otherwise shown.

j. Maximum distance between suspension points must be 10 feet or as recommended by the manufacturer, whichever is less.

3.1.2.2 Recessed and Semi-Recessed Luminaires

a. Support recessed and semi-recessed luminaires independently from the building structure by a minimum of two wires, straps or rods per luminaire and located near opposite corners of the luminaire. Secure horizontal movement with clips provided by manufacturer. Ceiling grid clips are not allowed as an alternative to independently supported luminaires.

b. Support round luminaires or luminaires smaller in size than the ceiling grid independently from the building structure by a minimum of four wires, straps or rods per luminaire, spaced approximately equidistant around.

c. Do not support luminaires by acoustical tile ceiling panels.

d. Where luminaires of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support each independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the luminaire.

e. Luminaires installed in suspended ceilings must also comply with the requirements of Section 09 51 00 ACOUSTICAL CEILINGS.

f. Adjust aperture rings on all applicable ceiling recessed luminaires to accommodate various ceiling material thickness. Coordinate cut-out size in ceiling to ensure aperture covers cut-out entirely. Install aperture rings such that the bottom of the ring is flush with finished ceiling or not more than 1/16 inch above. Do not install luminaires such that the aperture ring extends below the finished ceiling surface.

g. For luminaire recessed in plaster ceilings, provide plaster frames for setting. Install setting such that the bottom of the frame is flush with finished ceiling. Support luminaires with plaster frames utilizing yokes or leveling lugs. Do not mount luminaires or support elements to ducts or pipes. Yokes must support a luminaire by no fewer than two bolts each.

3.1.3 LED Drivers

Provide LED drivers integral to luminaire as constructed by the manufacturer.

3.1.4 Exit Signs

NFPA 101. Wire exit signs and emergency lighting units ahead of the local switch, to the normal lighting circuit located in the same room or area.

3.1.5 Lighting Controls

Refer to Section 25 05 11. CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS for additional lighting control installation requirements.

3.1.5.1 Occupancy/Vacancy Sensors

a. Provide quantity of sensor units indicated as a minimum. Provide additional units to give full coverage over controlled area. Full coverage must provide hand and arm motion detection for office and administration type areas and walking motion for industrial areas, warehouses, storage rooms and hallways.

b. Locate ceiling-mounted sensors no closer than 6 feet from the nearest HVAC supply or return diffuser.

c. Locate the sensor(s) as indicated and in accordance with the manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

3.2.1 Tests

3.2.1.1 Lighting Control Verification Tests

Verify lighting control system and devices operate according to approved sequence of operations. Verification tests are to be completed after commissioning.

a. Verify occupancy/vacancy sensors operate as described in sequence of operations. Provide testing of sensor coverage, sensitivity, and time-out settings in all spaces where sensors are placed. This is to be completed only after all furnishings have been installed. Submit occupancy/vacancy sensor verification test.

b. Verify wall box dimmers and scene wallstations operate as described in sequence of operations.

3.2.1.2 Emergency Lighting Test

Interrupt power supply to demonstrate proper operation of emergency lighting. If adjustments are made to the lighting system, re-test system to show compliance with standards.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Commissioning

NFPA 101. Commission all components of the lighting system and lighting control system in accordance with Section 01 91 00.15 BUILDING COMMISSIONING. Factory Trained Field Service Technician is responsible for calibration and programming sequences for input devices and systems in accordance with the requirements described in the sequence of operation.

3.3.2 Training

3.3.2.1 Maintenance Staff Training

Submit a Maintenance Staff Training Plan at least 30 calendar days prior to training session that describes training procedures for Owner's personnel in the operation and maintenance of lighting and lighting control system. Provide on-site training which demonstrates full system functionality, assigning schedules, calibration adjustments for light levels and sensor sensitivity, integration procedures for connecting to third-party devices, and manual override including information on appropriate use. Provide protocols for troubleshooting, maintenance, repair, and replacement, and literature on available system updates and process for implementing updates.

3.3.2.2 End-User Training

Submit an End-User Training Plan at least 30 calendar days prior to training session that describes training procedures for end-users on the lighting control system. Provide users with a list of control devices located within user-occupied spaces, such as photosensors and occupancy and vacancy sensors, including information on the proper operation and schedule for each device. Provide demonstration for each type of interface. Provide users with the building schedule as currently commissioned, including conditional programming based on astronomic time clock functionality. Provide users with the correct contact information for maintenance personnel who will be available to address any lighting control issues.

Provide laminated instructions to the user at each scene wallstation. Provide only instructions relevant to the functionality of the specific scene wallstation. Provide a description of each labeled scene control button. If the room utilizes occupancy/vacancy sensors or photosensors, include a description of this functionality on the instruction sheet.

-- End of Section --

SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM
08/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

ECIA EIA/ECA 310-E	(2005) Cabinets, Racks, Panels, and Associated Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-83-596	(2021) Indoor Optical Cable
ICEA S-90-661	(2021) Category 3 and 5E Individually Unshielded Twisted Pairs, Indoor Cables (With or Without an Overall Shield) for Use in General Purpose and LAN Communications Wiring Systems

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA/BICSI 568	(2006) Standard for Installing Building Telecommunications Cabling

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 66	(2019) Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pairs

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-21	(1988a; R 2012) FOTP-21 - Mating Durability of Fiber Optic Interconnecting

	Devices
TIA-526-14	(2023d) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-568.0	(2020e) Generic Telecommunications Cabling for Customer Premises
TIA-568.1	(2020e) Commercial Building Telecommunications Infrastructure Standard
TIA-568.2	(2018d) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-568.3	(2022e) Optical Fiber Cabling Components Standard
TIA-569	(2019e; Add 1 2022) Telecommunications Pathways and Spaces
TIA-606	(2021d) Administration Standard for Telecommunications Infrastructure
TIA-607	(2019d) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA-1152	(2016; R 2021) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
TIA/EIA-598	(2014D; Add 2 2018) Optical Fiber Cable Color Coding
TIA/EIA-604-10	(2021c) FOCIS 10 Fiber Optic Connector Intermateability Standard - Type LC

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 68	Connection of Terminal Equipment to the Telephone Network (47 CFR 68)

UNDERWRITERS LABORATORIES (UL)

UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 444	(2017; Reprint Jun 2021) UL Standard for Safety Communications Cables
UL 467	(2022) UL Standard for Safety Grounding and Bonding Equipment
UL 514C	(2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 969	(2017; Reprint May 2023) UL Standard for Safety Marking and Labeling Systems
UL 1286	(2022; Reprint Aug 2023) UL Standard for Safety Office Furnishings
UL 1863	(2004; Reprint Oct 2019) UL Standard for Safety Communication Circuit Accessories
UFC 3-580-01	TELECOMMUNICATIONS INTERIOR INFRASTRUCTURE PLANNING AND DESIGN, WITH CHANGE 1
Eglin 96th Comm Spec	(January 2024) Eglin 96th Communications Squadron Cyber Infrastructure Standards and Installation Specifications

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and Section 33 82 00 TELECOMMUNICATIONS, OUTSIDE PLANT (OSP), apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568.1, TIA-568.2, TIA-568.3, TIA-569, TIA-606 and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

1.3.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.3.3 Floor Distributor (FD)

A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

1.3.4 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.3.5 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including wireless) including the entrance point at the building wall and continuing to the equipment room.

1.3.6 Equipment Room (ER) (Telecommunications)

An environmentally controlled centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.7 Open Cable

Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

1.3.8 Open Office

A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.

1.3.9 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed horizontal cabling, horizontal pathways, work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting cabling necessary to transport telephone and data (including LAN) between equipment items in a building. The horizontal system shall be wired in a star topology from the telecommunications work area to the floor distributor or campus distributor at the center or hub of the star. Provide telecommunications pathway systems referenced herein as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. The telecommunications contractor must coordinate all work with 96 CS prior to ordering materials.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications Drawings; G

Telecommunications Space Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Telecommunications Cabling (backbone and horizontal); G

Patch Panels; G

Telecommunications Outlet/Connector Assemblies; G

Equipment Support Frame; G

Connector Blocks; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Telecommunications Cabling Testing; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Manufacturer Qualifications; G

Test Plan; G

SD-09 Manufacturer's Field Reports

Factory Reel Tests; G

SD-10 Operation and Maintenance Data

Telecommunications Cabling and Pathway System Data Package 5; G

SD-11 Closeout Submittals

Record Documentation; G

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00 SUBMITTAL PROCEDURES, submitted plan drawings shall be a minimum of 11 by 17 inches in size using a minimum scale of 1/8 inch per foot. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Drawings

Provide registered communications distribution designer (RCDD) approved, drawings in accordance with TIA-606. The drawings and installation must comply with UFC 3-580-01 and the Eglin 96th Comm Spec. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure in accordance with TIA-606. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the EF telecommunications and ER telecommunications, CD's, BD's, and FD's to the telecommunications work area outlets. The following drawings shall be provided as a minimum:

a. T1 - Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.

b. T2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID’S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.

c. T4 - Typical Detail Drawings - Faceplate Labeling, Firestopping, Americans with Disabilities Act (ADA), Safety, Department of Transportation (DOT). Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.

1.6.1.2 Telecommunications Space Drawings

Provide T3 drawings in accordance with TIA-606 that include telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet and wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568.1, TIA-568.2 and TIA-568.3.

1.6.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the components and accessories for each cable type specified, 72__ days prior to the proposed test date. Include procedures for certification, validation, and testing. The test plan shall be reviewed by the Eglin 96 CS.

1.6.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.10 MAINTENANCE

1.10.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system, Data Package 5. Submit operations and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data Package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION. Ensure that these drawings and documents depict the as-built configuration.

1.10.2 Record Documentation

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606 and as indicated in Eglin 96th Comm Spec. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in hard copy format and on electronic media using Windows based computer cable management software. Provide the following T5 drawing documentation as a minimum:

a. Cables - A record of installed cable shall be provided in accordance with TIA-606. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with TIA-606. Include manufacture date of cable with submittal.

b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with TIA-606. Documentation shall include the required data fields as a minimum in accordance with TIA-606.

PART 2 PRODUCTS

2.1 COMPONENTS

Components shall be UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein. All materials shall be approved by the 96 CS.

2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with TIA-569 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide system furniture pathways in accordance with UL 1286.

2.3 TELECOMMUNICATIONS CABLING

Cabling shall be UL listed for the application and shall comply with TIA-568.0, TIA-568.1, TIA-568.2, TIA-568.3 and NFPA 70. Provide a labeling system for cabling as required by TIA-606 and UL 969. Ship cable on reels or in boxes bearing manufacture date for for unshielded twisted pair (UTP) in accordance with ICEA S-90-661 and optical fiber cables in accordance with ICEA S-83-596 for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation shall not be used.

2.3.1 Horizontal Cabling

Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA-568.1.

2.3.1.1 Horizontal Copper

Provide horizontal copper cable, UTP, 100 ohm in accordance with TIA-568.2, UL 444, ANSI/NEMA WC 66, ICEA S-90-661 . Provide four each individually twisted pair, minimum size 24 AWG conductors, Category 6, with a thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) and length marking at regular intervals in accordance with ICEA S-90-661. Provide plenum (CMP) communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. Cables installed in conduit within and under slabs shall be UL listed and labeled for wet locations in accordance with NFPA 70.

2.3.1.2 Horizontal Optical Fiber

Provide optical fiber horizontal cable in accordance with ICEA S-83-596and TIA-568.3. Cable shall be tight buffered, multimode, 50/125-um diameter laser optimized, OM4. Cable shall be imprinted with manufacturer, flammability rating and fiber count at regular intervals not to exceed 40 inches.

Provide plenum (OFNP) rated non-conductive, fiber optic cable in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70.Cables installed in conduit within and under slabs be UL listed and labeled for wet locations in accordance with NFPA 70. The cable jacket shall be of single jacket construction with color coding of cordage jacket, fiber, unit, and group in accordance with TIA/EIA-598.

2.3.2 Work Area Cabling

2.3.2.1 Work Area Copper

Provide work area copper cable in accordance with TIA-568.2, with a thermoplastic jacket.

2.3.2.2 Work Area Optical Fiber

Provide optical work area cable in accordance with TIA-568.3.

2.4 TELECOMMUNICATIONS SPACES

Provide connecting hardware and termination equipment in the telecommunications equipment room to facilitate installation as shown on design drawings for terminating and cross-connecting permanent cabling. Provide telecommunications interconnecting hardware color coding in accordance with TIA-606.

2.4.1 Equipment Support Frame

Provide in accordance with ECIA EIA/ECA 310-E and UL 50.

a. Cabinets, wall-mounted modular type, 16 gauge steel or 11 gauge aluminum] construction , minimum, treated to resist corrosion. Cabinet shall have have lockable front doors, louvered side panels, ground lug, and top and bottom cable access. Cabinet shall be compatible with19 inches panel mounting. All cabinets shall be keyed alike. A duplex AC outlet shall be provided within the cabinet.

2.4.2 Connector Blocks

Provide insulation displacement connector (IDC) Type 110 for Category 6 systems. Provide blocks for the number of horizontal and backbone cables terminated on the block plus 25 percent spare.

2.4.3 Cable Guides

Provide cable guides specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on19 inches equipment cabinets. Cable guides of ring or bracket type devicescabinet for horizontal cable management and individually mounted for vertical cable management. Mount cable guides with screws, and or nuts and lockwashers.

2.4.4 Patch Panels

Provide ports for the number of horizontal and backbone cables terminated on the panel plus 25 percent spare. Provide pre-connectorized optical fiber and copper patch cords for patch panels. Provide patch cords, as complete assemblies, with matching connectors as specified. Provide fiber optic patch cables with crossover orientation in accordance with TIA-568.3. Patch cords shall meet minimum performance requirements specified in TIA-568.1, TIA-568.2 and TIA-568.3 for cables, cable length and hardware specified.

2.4.4.1 Modular to 110 Block Patch Panel

Provide in accordance with TIA-568.1 and TIA-568.2. Panels shall be third party verified and shall comply with EIA/TIA Category 6 requirements. Panel shall be constructed of 0.09 inches minimum aluminum and shall be cabinet mounted and compatible with an ECIA EIA/ECA 310-E 19 inches equipment cabinet. Panel shall provide 48 non-keyed, 8-pin modular ports, wired to T568A. Patch panels shall terminate the building cabling on Type 110 IDCs and shall utilize a printed circuit board interface. The rear of each panel shall have incoming cable strain-relief and routing guides. Panels shall have each port factory numbered and be equipped with laminated plastic nameplates above each port.

2.4.4.2 Fiber Optic Patch Panel

Provide panel for maintenance and cross-connecting of optical fiber cables. Panel shall be constructed of 1618 gauge steel or 11 gauge aluminum minimum and shall be cabinet mounted and compatible with a ECIA EIA/ECA 310-E19 inches equipment rack. Each panel shall provide multimode adapters as duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves, alignment sleeves. Provide dust cover for unused adapters. The rear of each panel shall have a cable management tray a minimum of 8 inches deep with removable cover, incoming cable strain-relief and routing guides. Panels shall have each adapter factory numbered and be equipped with laminated plastic nameplates above each adapter.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

2.5.1 Outlet/Connector Copper

Outlet/connectors shall comply with FCC Part 68, TIA-568.1, and TIA-568.2. UTP outlet/connectors shall be UL 1863 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and shall be third party verified and shall comply with TIA-568.2 Category 6 requirements. Outlet/connectors provided for UTP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet/connector shall be wired T568A. UTP outlet/connectors shall comply with TIA-568.2 for 200 mating cycles.

2.5.2 Optical Fiber Adapters(Couplers)

Provide optical fiber adapters suitable for duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves, as indicated. Provide dust cover for adapters. Optical fiber adapters shall comply with

TIA-455-21 for 500 mating cycles.

2.5.3 Optical Fiber Connectors

Provide in accordance with TIA-455-21. Optical fiber connectors shall be duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves, ferrule, epoxyless crimp style compatible with 50/125 multimode fiber. The connectors shall provide a maximum attenuation of 0.3 dB at 850 nm with less than a 0.2 dB change after 500 mating cycles.

2.5.4 Cover Plates

Telecommunications cover plates shall comply with UL 514C, and TIA-568.1, TIA-568.2, TIA-568.3; flush or oversized design constructed of high impact thermoplastic material white in color. Provide labeling in accordance with the paragraph LABELING in this section.

2.6 MULTI-USER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

Provide MUTOA(s) in accordance with TIA-568.1.

2.7 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA-607, and NFPA 70. Components shall be identified as required by TIA-606. Provide ground rods, bonding conductors, and grounding busbars as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.8 FIRESTOPPING MATERIAL

Provide as specified in Section 07 84 00 FIRESTOPPING.

2.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.10 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inches thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inches high normal block style.

2.11 TESTS, INSPECTIONS, AND VERIFICATIONS

2.11.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with TIA-568.1, TIA-568.2, TIA-568.3, and TIA-526-14 for multimode optical fiber cables.

PART 3 EXECUTION

3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with NECA/BICSI 568, TIA-568.1, TIA-568.2, TIA-568.3, TIA-569, NFPA 70, and UL standards as applicable. Provide cabling in a star topology network. Pathways and outlet boxes shall be installed as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling. Cabling shall be run with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

3.1.1 Cabling

Install UTP, and optical fiber telecommunications cabling system as detailed in TIA-568.1, TIA-568.2, TIA-568.3. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.

3.1.1.1 Open Cable

Use only where specifically indicated on plans for use in cable trays, or below raised floors. Install in accordance with TIA-568.1, TIA-568.2 and TIA-568.3. Do not exceed cable pull tensions recommended by the manufacturer. Copper cable not in a wireway or pathway shall be suspended a minimum of8 inches above ceilings by cable supports no greater than 60 inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches shall be maintained when such placement cannot be avoided.

Plenum cable shall be used where open cables are routed through plenum areas. Cable routed exposed under raised floors shall be plenum rated. Plenum cables shall comply with flammability plenum requirements of NFPA 70. Install cabling after the flooring system has been installed in raised floor areas. Cable 6 feet long shall be neatly coiled not less than 12 inches in diameter below each feed point in raised floor areas.

3.1.1.2 Horizontal Cabling

Install horizontal cabling as indicated on drawings Do not untwist Category 6 UTP cables more than one half inch from the point of termination to maintain cable geometry. Provide slack cable in an out and back fashion maintaining its natural on each end of the cable, 10 feet in the telecommunications room, and 12 inches in the work area outlet.

3.1.2 Pathway Installations

Provide in accordance with TIA-569 and NFPA 70. Provide building pathway as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.3 Cable Tray Installation

Install cable tray as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Only CMP and OFNP type cable shall be installed in a plenum.

3.1.4 Work Area Outlets

3.1.4.1 Terminations

Terminate UTP cable in accordance with TIA-568.1, TIA-568.2 and wiring configuration as specified. Terminate fiber optic cables in accordance with TIA-568.3.

3.1.4.2 Cover Plates

As a minimum, each outlet/connector shall be labeled as to its function and a unique number to identify cable link in accordance with the paragraph LABELING in this section.

3.1.4.3 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 12 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturer's bend radius for each type of cable shall not be exceeded.

3.1.4.4 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

3.1.4.5 Multi-User Telecommunications Outlet Assembly (MUTOA)

Run horizontal cable in the ceiling or underneath the floor and terminate each cable on a MUTOA in each individual zone. MUTOAs shall not be located in ceiling spaces, or any obstructed area. MUTOAs shall not be installed in furniture unless that unit of furniture is permanently secured to the building structure. MUTOAs shall be located in an open work area so that each furniture cluster is served by at least one MUTOA. The MUTOA shall be limited to serving a maximum of twelve work areas. Maximum work area cable length requirements shall also be taken into account. MUTOAs must be labeled to include the maximum length of work area cables. MUTOA labeling is in addition to the labeling described in TIA-606, or other applicable cabling administration standards. Work area cables extending from the MUTOA to the work area device must also be uniquely identified and labeled.

3.1.5 Telecommunications Space Termination

Install termination hardware required for Category 6 and optical fiber system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

3.1.5.1 Connector Blocks

Connector blocks shall be cabinet mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Install in accordance with industry standard wire routing guides in accordance with TIA-569.

3.1.5.2 Patch Panels

Patch panels shall be mounted in equipment cabinets with sufficient ports to accommodate the installed cable plant plus 25 percent spares.

a. Copper Patch Panel. Copper cable entering a patch panel shall be secured to the panel as recommended by the manufacturer to prevent movement of the cable.

b. Fiber Optic Patch Panel. Fiber optic cable loop shall be provided as recommended by the manufacturer. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.5.3 Equipment Support Frames

Install in accordance with TIA-569:

d. Cabinets, wall-mounted modular type. Mount cabinet to plywood backboard in accordance with manufacturer's recommendations. Mount cabinet so height of highest panel does not exceed 78 inches above floor.

3.1.6 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified in Section 07 84 00 FIRESTOPPING.

3.1.7 Grounding and Bonding

Provide in accordance with TIA-607, NFPA 70 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.2 LABELING

3.2.1 Labels

Provide labeling in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using laser printer .

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA-606.

3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with TIA-606.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3.1 Painting Backboards

If backboards are required to be painted, then the manufactured fire retardant backboard must be painted with fire retardant paint, so as not to increase flame spread and smoke density and must be appropriately labeled. Label and fire rating stamp must be unpainted.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 TESTING

3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568.1, TIA-568.2, TIA-568.3. Test equipment shall conform to TIA-1152. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure. 96 CS shall witness all tests. 96 CS/SCOW shall perform at minimum 2 in-progress inspections (25% and 75%) and a final acceptance inspection with 96 CS personnel present for all final verification and acceptance tests. Contractor shall notify 96 CS/SCXP at least 72 hours prior to each in-progress and final inspections.

3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568.1, TIA-568.2, TIA-568.3, . Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

3.5.1.2 Verification Tests

UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but prior to being cross-connected.

For multimode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568.3 and TIA-526-14 using Method A, Optical Power Meter and Light Source for multimode optical fiber. Perform verification acceptance tests.

Test report results shall reflect the wiring scheme that was selected during design/installation (i.e. 568A or 568B). Fiber and Copper test equipment must be calibrated within one year of installation use or test requirements. Test results shall be test equipment exported products from calibrated device only, fiber links will illustrate bi-directinoal results. No handwritten or typed out results will be accepted. All test cables shall be factory made.

3.5.1.3 Performance Tests

Perform testing for each outlet and MUTOA as follows:

a. Perform Category 6 link tests in accordance with TIA-568.1 and TIA-568.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.

b. Optical fiber Links. Perform optical fiber end-to-end link tests in accordance with TIA-568.3.

3.5.1.4 Final Verification Tests

Perform verification tests for UTP and optical fiber systems after the complete telecommunications cabling and workstation outlet/connectors are installed. 96 CS/SCOW personnel to be on site to verify all ISP and fiber testing by the contractor prior to acceptance.

a. Voice Tests. These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and DSN telephone call.

b. Data Tests. These tests assume the Information Technology Staff has a network installed and are available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

-- End of Section --

SECTION 28 08 10

ELECTRONIC SECURITY SYSTEM ACCEPTANCE TESTING
08/23

PART 1 GENERAL

1.1 SUMMARY

This specification defines the process and procedures for initial acceptance testing of electronic security systems (ESS) to include intrusion detection, access control and video as well as associated power and communications. Requirements to plan, conduct, and document all testing activities are covered along with the Government responsibility to witness testing and review and approve submittals. During the course of the acceptance test, demonstrate that, without exception, the completed and integrated ESS complies with the contract requirements.

1.2 DEFINITIONS

The Government Representative is a qualified individual given specific authority to witness system acceptance testing and evaluate the results.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05 Design Data

Test Plan; G

SD-06 Test Reports

Final Test Report; G

Pre-Acceptance Test Certification; G

SD-07 Certificates

Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 General

The Test Director, Operator, and Technician must have prior experience with the specific equipment, hardware and software installed under the contract.

1.4.1.2 Test Director

The Test Director must have at least five years of hands-on ESS experience to include any combination of design, installation, testing and maintenance.

1.4.1.3 Operator

The Operator must have at least two years of hands-on experience installing and maintaining ESS workstations to include both hardware and software. The Operator must be capable of demonstrating all workstation features and capabilities.

1.4.1.4 Technician

The technician must have at least two years of hands-on experience installing and maintaining ESS field equipment to include sensors, card readers, cameras, local processors, and communications equipment. The Technician must be capable of demonstrating all features and capabilities of ESS field equipment. Qualifications may be met by the individual experience of one technician or by the combined experience of a team of technicians.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TEST PLAN

The Government will witness all system acceptance testing and endurance testing. Obtain written permission from the Government before proceeding with testing. Clearly establish the scope for ESS testing prior to beginning testing. Submit a Test Plan that addresses all testing requirements to include the following topics:

3.1.1 Personnel

Identify the Test Director, Operator, Technician, [Test Intruder], and any other personnel that will be performing test activities.

3.1.2 Equipment

List all equipment that is required to support testing. State the purpose of each piece of equipment. Describe equipment that will be used to enable voice communications between the monitoring location and the field.

3.1.3 Procedures

Provide a step-by-step procedure for conducting each functional test. Describe actions and expected results. Ensure that functional test procedures address performance standards described in contract specifications especially any probability of detection (Pd) and nuisance and false alarm rate (NAR/FAR) requirements. Pd and NAR/FAR are not typically a concern for interior sensors installed per manufacturers specifications. For exterior sensors NAR/FAR needs to be verified but Pd may not need to be verified if installed IAW manufacturers or service specific guidance.

Download example procedures from http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic and review for applicability and completeness. Adapt example procedures to meet specific project requirements and develop additional ones as needed. Follow TEST-MASTERTP0023-005 for Air Force projects.

3.1.4 Special Provisions

Discuss any special test provisions such as facility access, safety, integration with existing systems, and coordination with other work.

3.1.5 Test Logs

Provide logs for recording all data from functional testing and burn-in testing.

Download example logs from http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic and review for applicability and completeness. Adapt example logs to identify each component by location to meet specific project components and system test requirements. Develop additional logs as needed.

3.1.6 Schedule

Provide an overall schedule that includes all testing milestones.

3.2 PRE-ACCEPTANCE TESTING

Conduct a complete test of all field equipment, workstations, and central system hardware and software in accordance with the approved Test Plan. The Test Director must be on site to conduct a pre-test inspection and oversee all testing activities. Prior to testing, visually inspect all ESS components and correct workmanship and neatness deficiencies as needed. During the pre-test inspection, verify the accuracy of redline drawings and update drawings as needed. Verify and document performance of each device and system feature to include sensor nuisance and false alarm rates. Review all positioning and field of view adjustments for each camera view in day and night operation.

Prepare and submit Pre-Acceptance Test Certification detailing the results of the testing. Refer to paragraph FINAL TEST REPORT for required content. Include a cover letter signed by the Test Director stating that pre-acceptance testing has been completed and that the system is ready for acceptance testing.

3.3 SYSTEM ACCEPTANCE

Test the ESS in accordance with the approved Test Plan in the presence of the Government Representative to certify acceptable performance. Verify that the total system meets all requirements of the specification and complies with the specified standards.

Demonstrate that the completed system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project must be demonstrated and shown. The SAT, as specified, is not to be started until after receipt by the Contractor of written permission from the Government.

Begin acceptance testing upon arrival of the Government Representative at the project site. Place the ESS in normal operating mode and evaluate system performance during the testing period. Immediately report any deficiencies observed during testing to the Government Representative and discuss possible causes and corrective measures. Obtain Government approval prior to making any adjustments, repairs or modifications. The Government retains the right to terminate testing at any time the ESS is found to be incomplete or fails to perform as specified. Such termination of acceptance testing constitutes a FAILED system acceptance test.

Upon termination of testing by the Government or by the Contractor, commence an assessment period as described in paragraph Test Termination Assessment Period.

Upon successful completion of the system acceptance test, deliver test reports and other documentation as specified to the Government prior to commencing the endurance test.

3.3.1 Test Termination Assessment Period

Identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Government. Ensure that the report explains in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed. After delivering the written report, convene a test review meeting to present the results and recommendations to the Government. Schedule the test review meeting at least 5 business days after receipt of the report by the Government. As a part of this test review meeting, demonstrate that all failures have been corrected by performing appropriate portions of the system acceptance test. Based on the Contractor's report and the test review meeting, the Government will determine the restart date, or may require that the entire test be repeated.

3.3.2 Preparation

Notify the Contracting Officer of system readiness 15 days prior to the expected start date of acceptance testing. Prior to acceptance testing, complete all clean-up and patch work requirements. Ensure that security equipment closets and similar areas are free of accumulation of waste materials or rubbish caused by prior installation work.

3.3.3 Personnel

Ensure that the following personnel are on site to perform test activities: Test Director, Operator, Technician. Ensure that the Quality Control Manager is on site during acceptance testing.

3.3.4 Visual Inspection

Assist the Government Representative in conducting a visual inspection of ESS equipment and wiring. This inspection will focus on the general neatness and quality of workmanship and compliance with applicable codes and manufacturers' recommended installation methods. Provide a comprehensive listing of installed equipment and software, sorted by location, along with a complete set of ESS red line drawings to be used during the inspection. Document deficiencies identified during the inspection.

3.3.5 Phased Testing

3.3.5.1 Functional Testing

During the functional testing, verify system performance in accordance with the approved Test Plan. Record results in approved Test Logs and provide a written explanation of each failure to include cause, corrective action, and retest result. Continue functional testing until all tests have been successfully completed with no unresolved failures. Comply with requests from the Government Representative to repeat functional tests performed previously. The Government reserves the right to request the Contractor to repeat all functional tests or a representative sampling thereof as a means of performance verification. Document all test results on approved Test Logs.

3.3.5.2 System Activity Reports

Retrieve archived data from the system and provide unaltered activity reports as requested by the Government Representative. Reports may address any type of activity to include alarms, portal transactions, and video archives. Assist with analyzing reports to identify trends and anomalies.

3.3.5.3 Corrective Actions

Correct any deficiencies in coordination with the Government Representative. Maintain a punch list and review status at the end of each day. Work diligently to complete corrective actions the same day that deficiencies are observed. Add deficiencies not corrected on the same day to the rework items list maintained by the Quality Control Manager. Failure to resolve punch list items to the satisfaction of the Government constitutes a FAILED system acceptance test.

3.3.5.4 Endurance Testing

Following the successful completion of the functional test and completion of all corrective actions, monitor all components for a continuous period of 24 hours upon written approval from the government representative. Active monitoring will take place for a total of 24 hours per day. All events, anomalies, and alarms will be reviewed, assessed in real time, and documented. Date and time of each activation will be recorded, assessed for cause, and noted. All cameras are to be reviewed for operability and clarity of view, day, and night.

The endurance test must demonstrate system reliability and operability. The endurance test will not be started until the Government notifies the Contractor, in writing, that the system acceptance test is satisfactorily completed, and correction of all outstanding deficiencies has been satisfactorily completed.

Provide 1 operator to operate the system 24 hours per day in addition to any Government personnel that may be made available. The Government may terminate testing at any time if the system fails to perform as specified.

Upon termination of testing by the Government or by the Contractor, commence an assessment period as defined in paragraph Test Termination Assessment Period. Verify the operation of each terminal device during the last day of the test. Upon successful completion of the endurance test, deliver test reports and other documentation as specified to the

Government prior to acceptance of the system.

The endurance test for sensors is required to demonstrate the configuration meets the requirements of Section 28 10 05 ELECTRONIC SECURITY SYSTEMS (ESS) paragraphs False Alarm Rate and Nuisance Alarm Rate. The Government Representative must be directly notified if any section of the fence exceeds the requirement. Upon coordination, re-calibrate the failed section, repeat functional test, and restart the endurance test period for that section.

3.4 FINAL TEST REPORT

Submit a Final Test Report following the successful completion of acceptance testing to include all failures, remediation, and resolution of all punch list items. Address the following topics in the Final Test Report:

3.4.1 Summary

Provide a chronological summary of all testing. Describe test activities and results in narrative form.

3.4.2 Personnel

Provide a list of all Contractor and Government personnel who participated in the testing.

3.4.3 Test Logs

Provide all completed test logs along with a test log verification signed by the Test Director.

3.4.4 False and Nuisance Alarm Rates

Provide a tabulated and summarized listing of all events based on the system activity reports. Categorize every alarm as one of four types: 1) Valid/Actual, 2) False, 3) Nuisance, or 4) Test/Authorized Alarm.

3.4.4.1 Valid or Actual Alarm

An alarm received due to an actual intruder attempting to enter or entering a protected area or attempting to cross or crossing a line of detection.

3.4.4.2 False Alarm

An alarm received for which no cause can be determined. Typically, false alarms are due to aging or malfunctioning equipment and communications pathways that the alarm monitor cannot assess. False alarms in excess of established rates will cause complacency and lead to unsecure protected areas.

3.4.4.3 Nuisance Alarm

An alarm received due to an influence for which the sensor was designed to detect but which is not related to an intrusion attempt. The influence that caused the alarm must be clearly identifiable. These alarms fall into three categories: preventable, mitigatable, and unpreventable. Preventable nuisance alarms typically include personnel using improper entry/exit procedures, or an unauthorized incursion into the sensor zone.

Preventable nuisance alarms must be included in the nuisance alarm rate. Mitigatable nuisance alarms can include: an animal entering into the sensor zone; a weather event typical/normal to the area, a noise event (i.e., a jet taking off in afterburner, a training explosion from the base range, etc.), or a seismic event (large vehicle vibrations from regular traffic in the area). Steps must be taken to reduce mitigatable events such as critter/animal control fences or animal abatement, bird abatement programs such as Bird/wildlife Aircraft Strike Hazard (BASH) or reprograming the system to filter out certain vibrations/noises. Mitigatable nuisance alarms must be included in the nuisance alarm rate. Unpreventable nuisance alarms can include a weather event not typical/normal to the area (i.e., thunderstorm, hurricane, typhoon, etc.) or other atypical events to the area and will not be included in the nuisance alarm rate. Nuisance alarms in excess of established rates will cause complacency and lead to unsecure protected areas.

3.4.4.4 Test or Authorized Alarm

An alarm received due to authorized personnel performing required testing on the ESS. Tests can include daily, weekly, or monthly operational checks as well as acceptance, quarterly, semi-annual, or annual system functional checks.

3.5 Probability of Detection and Confidence Level

If Probability of Detection (Pd) requirements need to be validated, then Pd testing must be completed. The binomial table below uses a statistical method to determine Pd and Confidence level based on the number of sequential annunciated alarms due to test intrusions. Regulatory or contractual requirements will define the Pd and Confidence Level needed for specific zones or lines of detection. If the number of successive detections cannot be met without a missed detection, then adjustments to detection sensor coverage and sensitivity must be made.

Probability of Detection	0.9	0.9	0.95	0.95	Number of Misses Allowed
Confidence Level	90%	95%	90%	95%	
Number of Intrusion Attempts	22	29	45	59	0
	38	46	77	93	1
	52	61	105	124	2
	65	76	132	153	3
	78	89	158	181	4
	91	103	184	208	5

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SECTION 28 10 05

ELECTRONIC SECURITY SYSTEMS (ESS)
05/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B32	(2020) Standard Specification for Solder Metal

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2023) National Electrical Safety Code

INTELLIGENCE COMMUNITY STANDARD (ICS)

ICS 705-1	(2010) Physical and Technical Security Standard for Sensitive Compartmented Information Facilities

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ANSI ISO/IEC 7816	(R 2009) Identification Cards - Integrated Circuit Cards

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2022) Standard for Industrial Control and Systems: General Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST FIPS 201-2	(2013) Personal Identity Verification (PIV) of Federal Employees and Contractors

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 294	(2023) UL Standard for Safety Access Control System Units
UL 634	(2007; Reprint Mar 2015) Connectors and Switches for Use with Burglar-Alarm Systems
UL 639	(2007; Reprint Nov 2019) Standard for Intrusion Detection Units
UL 681	(2014; Reprint Jan 2021) UL Standard for Safety Installation and Classification of Burglar and Holdup Alarm Systems
UL 796	(2020; Reprint Sep 2022) UL Standard for Safety Printed Wiring Boards
UL 1037	(2016; Reprint Aug 2023) UL Standard for Safety Antitheft Alarms and Devices
UL 1076	(2018; Reprint Feb 2021) UL Standard for Safety Proprietary Burglar Alarm Units and Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

ESS Components; G

SD-03 Product Data

Detection Sensors; G

Access Control Devices; G

SD-05 Design Data

Backup Battery Capacity Calculations; G

SD-07 Certificates

Contractor Qualifications; G

Instructor Qualifications; G

Data Encryption; G

SD-10 Operation and Maintenance Data

SD-11 Closeout Submittals

As-Built Drawings; G

1.3 QUALITY ASSURANCE

1.3.1 Regulatory Requirements

The advisory provisions in each of the publications referred to in this specification are mandatory. Interpret these publications as though the word "must" has been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.3.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening, and have been utilized in applications of equipment and materials under similar circumstances and of similar size.

b. Have been available on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer.

d. Provide commercial off-the-shelf (COTS) products in which the manufacturer allows a network of qualified distributors to sell, install, integrate, maintain, and repair the hardware and software products that make up the system.

1.3.2.1 Alternative Qualifications

Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.3.2.2 Material and Equipment Manufacturing Date

Products manufactured more than one year prior to date of delivery to the site are not acceptable.

1.3.2.3 Product Safety

System components are to conform to applicable rules and requirements of NFPA 70. Equip system components with instruction stickers including warnings and cautions describing physical safety, and special or important procedures to be followed in operating and servicing system equipment.

1.3.3 Shop Drawings

1.3.3.1 ESS Components

Submit the ESS Components, Data Package 4 with the ESS Software submittal package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.Submit drawings that clearly and completely indicate each ESS component function that includes:

a. Termination device points

b. Interconnections required for system operation

c. Interconnections between modules and devices

d. Proposed wireway or conduit systems to be used including:

(1) Locations

(2) Sizes

(3) Types

e. Drawings showing:

(1) Device locations and spacing

(2) Mounting and positioning details

(3) Riser Diagrams with cable sizes and types

(4) Bill of Materials (Device make, model and quantities)

(5) Alarm and access control zones

(6) CCTV and sensor coverage areas

(7) Spare capacity

1.3.3.2 Overall System Schematic

Indicate the relationship of integrated components on one-line diagram and show:

a. Power source

b. System controls

c. Impedance matches

d. Interconnecting wire data including:

(1) Number

(2) Size

(3) Identification

(4) Maximum lengths

1.3.4 Evidence of Experience and Qualifications

1.3.4.1 Contractor Qualifications

Submit experience and certified qualifications data prior to installation. Show that specific installers who will perform the work have a minimum of 2 years of experience successfully installing ESS of the same type and similar design as specified. Include the names, locations, and points of contact of at least two installations of similar type and design as specified in this document where the installer has installed such systems. Indicate the type of each system installed. Certify that each system has performed satisfactorily in the manner intended for a period of at least 12 months.

1.3.4.2 Instructor Qualifications

Submit the instructor's experience and certified qualifications data prior to installation. Show that the instructor has received a minimum of 24 hours of ESS training from a technical organization such as the National Burglar and Fire Alarm Association, and 2 years experience in installing the specified ESS type.

1.4 Environmental Conditions

1.4.1 Interior Conditions

Equipment installed in environmentally protected interior areas must meet performance requirements specified for the following ambient conditions:

1.4.1.1 Temperature

32 to 120 degrees F. Components installed in unheated security protected areas must meet performance requirements for temperatures as low as 0 degrees F

1.4.1.2 Pressure

Sea level to 15,000 feet above sea level

1.4.1.3 Relative Humidity

5 to 95 percent

1.4.1.4 Fungus

Components must be constructed of non fungus nutrient materials or be treated to inhibit fungus growth

1.4.1.5 Acoustical Noise

Components must be suitable for use in high noise areas above 100 dB, without adversely affecting their performance

1.4.2 Exterior Conditions

Components in enclosures must meet performance requirements when exposed to the following ambient conditions:

1.4.2.1 Temperature

Minus 25 to 140 degrees F

1.4.2.2 Pressure

Sea level to15,000 feet above sea level

1.4.2.3 Solar Radiation

Six hours of solar radiation per day at dry bulb temperature of 120 degrees F including 4 hours of solar radiation at 104 watts per square foot

1.4.2.4 Rain

2 inches per hour and 5 inches per hour cyclic with wind plus one period of 12 inches per hour

1.4.2.5 Humidity

5 to 95 percent

1.4.2.6 Wind

Continual velocity up to 50 mph with gusts to 66 mph, except that fence sensors must detect intrusions up to 35 mph

1.4.2.7 Acoustical Noise

Components must be suitable for use in high noise areas above 110 dB without adversely affecting their performance. Examples areas include flight lines, run-up pads, and generator sites.

1.5 SYSTEM CALCULATIONS AND ANALYSIS

1.5.1 Backup Battery Capacity Calculations

Submit calculations showing that backup battery capacity exceeds sensor operation, communications supervision, and alarm annunciation power requirements for proposed equipment plus 25 percent spare capacity.

1.6 AS-BUILT DRAWINGS

Maintain a separate set of drawings, elementary diagrams, and wiring diagrams of the system to be used for as-built drawings. Keep this set accurately and neatly up-to-date with all changes and additions. This set is not to be used for installation purposes.

Finish the final drawings submitted with the endurance test report in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS for as-built requirements.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide new devices as required that are compatible with the existing Lenel access control system and Advantor intrusion detection system. Include materials not normally furnished by the manufacturer with the ESS equipment as specified in:

a. Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

2.2 PERFORMANCE REQUIREMENTS

Integrate the installed devices to the existing systems. Provide electronic equipment that complies with 47 CFR 15 and are suitable for the environment where they will be installed.

2.2.1 Maintainability

Provide components that can be maintained using commercially available tools and equipment. Arrange and assemble components to be readily accessible to maintenance personnel without compromising system defeat resistance and with no degradation in tamper protection, structural integrity, EMI or RFI attenuation, or line supervision after maintenance when it is performed in accordance with manufacturer's instructions.

2.2.2 Availability

Provide components rated for continuous operation. Provide solid-state electronic components mounted on printed circuit boards, conforming to UL 796. Provide boards that are plug-in, quick-disconnect type. Do not impede maintenance with densely packed circuitry. Provide power-dissipating components with safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current-carrying capacity. Provide solid-state type or hermetically sealed electromechanical type light duty relays and similar switching devices.

2.2.3 Controls and Designations

Provide controls and designations as specified in NEMA ICS 1.

2.2.4 Special Test Equipment

Provide all special test equipment, special hardware, software, tools, and programming or initialization equipment needed to start or maintain any part of the system and its components. Special test equipment is defined as any test equipment not normally used in an electronics maintenance facility.

2.2.5 Electromagnetic Interference (EMI)

Configure ESS components employing electromagnetic radiation constructed to provide minimal vulnerability to electronic countermeasures.

2.2.6 Electromagnetic Radiation (EMR)

Provide only ESS communication components which are Federal Communications Commission (FCC) licensed and approved. Provide system components which are electromagnetically compatible.

2.2.7 Interchangeability

Use off-the-shelf components which are physically, electrically, and functionally interchangeable with equivalent components as complete items. Equivalent, replacement components must not require new or other component modification. Do not use custom designed or one-of-a-kind items. Interchangeable components or modules must not require trial and error matching in order to meet integrated system requirements, system accuracy, or restore complete system functionality.

2.3 INTRUSION DETECTION SYSTEM (IDS)

The IDS system is existing and to remain. New components shall connect into the existing system.

2.3.1 IDS Components

Provide components:

a. Detection Sensors

2.3.2 Detection Sensors

a. Sensors are to detect facility perimeter or protected zone penetrations by unauthorized personnel or intruders and transmit an alarm signal to the alarm annunciation system upon change detection. Accomplish this with a probability of detection (PD) of 0.9 with a 95 percent confidence level and conforming to UL 639 where applicable.

b. Required sensor power shall match existing system.

c. An interior IDS zone is a room or space within a building that can be armed and disarmed independently from all other zones.

d. Provide line supervision for all sensors with an end-of-line resistor at the sensor or within a tampered junction box with conduit from the junction box to the sensor.

d. Provide sensors and components rated for operation in the installed environment. The sensors must transmit an alarm signal to the alarm annunciation system upon change detection. Provide all sensors with a tamper switch and elements housed in a tamper-alarmed enclosure in accordance of paragraph "Component Enclosure".

2.3.2.1 Interior Sensors

2.3.2.1.1 High Security Balanced Magnetic Switch (BMS)

Mount the BMS inside the secure location and on the opening side of the door. BMS sensors do not have the capability to incorporate an end-of-line (EOL) resistor.

2.3.2.1.1.1 Level 1 Switch

UL 634. Level 1 High Security

2.3.2.1.1.2 Level 2 Switch

UL 634. Level 2 High Security

2.3.2.1.2 Dual Technology Sensors

UL 639. Provide sensor combining passive infrared (PIR) and microwave sensors configured and manufactured specifically to be mounted in a single tamper alarmed enclosure. The sensor must provide selectable "AND" logic or "OR" logic for alarm indication configured in the "OR" logic state. Provide sensors that have a local means of indicating detection for use during installation and calibration with a means of disabling the indication.

The sensor is to have an LED walk test indicator which is not visible during normal operations. When visible, the walk test indicator will light when the sensor detects an intruder. Provide a sensor equipped with a manual control, located within the sensor's housing, to enable and disable the test indicator or with the test indicator located within the sensor housing so that it can only be seen when the housing is open or removed.

2.4 ACCESS CONTROL SYSTEM (ACS)

The access control system is existing to remain. New components shall connect into the existing system.

2.4.1 ACS Programming

2.4.1.1 Door Outputs

Provide each access control reader with two dedicated relay outputs. Both relays are to provide Normally Open and Normally Closed contacts. Use the first relay for electric lock control while the second is software configurable to activate for door forced open, door left open too long, duress, passback violations, invalid access attempts and valid unlock conditions. Allow for both relays to be separately programmable for energize times from 1 second to 10 minutes. The second relay must allow a delay time to be specified, causing its activation to be delayed after an activating condition occurs.

2.4.1.2 Two Person Rule

Any access control reader on the system is to have the ability via software programming to require two valid cards for access. Any access control reader on the system that includes a keypad is to also have the ability to require a valid PIN number associated with each of the two valid cards.

2.4.2 Access Control Devices

UL 294. The card, card reader, and panels must meet encryption requirements that are specified in paragraph DATA ENCRYPTION. Devices are to be tamper alarmed, tamper and vandal resistant, and solid state, containing no electronics which could compromise the access control subsystem should the subsystem be attacked.

2.4.2.1 Card Readers

Provide surface, card readers as indicated for each individual location. Provide and contactless type card readers capable of reading Keypad CAC and Keypad type of access control cards.

Keypads must contain an alphanumeric and special symbols keyboard with symbols arranged in ascending ASCII code ordinal sequence . Provide keypad integrated into the card reader.

2.4.2.1.1 Contactless Card Readers

Provide contactless card readers that can read credential CAC cards whose characteristics of size and technology meet those defined by ANSI ISO/IEC 7816 in close proximity to the card reader and are in compliance with NIST FIPS 201-2.

Provide readers with "flash" download capability to accommodate card format changes and the capability of reading the card data and transmitting the data, or a portion thereof, to the ESS control panel.

2.4.2.1.2 Card Reader Response Time

The card reader is to respond to passage requests by generating a signal to the local processor.

2.4.2.1.3 Card Reader Power

Power the card reader from the source as shown on the drawings. The card reader must not dissipate more than 5 Watts.

2.4.2.1.4 Card Reader Mounting Method

Provide card readers suitable for surface, , , or mounting as required.

2.4.2.2 Keypads

Entry control keypads are to use unique alphanumeric and other symbol combinations as an identifier. Keypads must contain an integral alphanumeric and special symbols keyboard with symbols arranged in ascending ASCII code ordinal sequence . Communications protocol is to be compatible with the local processor.

2.4.2.2.1 Keypad Display

Keypads are to include an LED or other type of visual indicator display and provide visual status indications indicating power ON and OFF and whether user passage requests have been accepted or rejected.

The maximum horizontal and vertical viewing angles are to be limited by the keypad display or enclosure. The maximum horizontal viewing angle must be no more than plus and minus 5 degrees off a vertical plane perpendicular to the plane of the face of the keypad display. The maximum vertical viewing angle must be no more than plus and minus 15 degrees off a horizontal plane perpendicular to the plane of the face of the keypad display.

2.4.2.2.2 Keypad Response Time

The keypad is to respond to passage requests by generating a signal to the local processor.

2.4.2.2.3 Keypad Power

Power the keypad from the source as shown on the drawings. The keypad must not dissipate more than 5 Watts.

2.4.2.2.4 Keypad Mounting Method

Provide keypads suitable for surface, , , or mounting as required.

2.4.2.2.5 Keypad Duress Codes

Provide a means for users to indicate a duress situation by entering a special code into the keypad.

2.4.2.3 Card Readers with Integral Keypad

Equip contact and contactless card readers with integral keypads as specified in paragraph "Keypads".

2.5 FACTORY APPLIED FINISH

Electrical equipment is to have factory-applied painting systems which meets the requirements of the NEMA 250 corrosion-resistance test as a minimum.

PART 3 EXECUTION

3.1 INSTALLATION

Install the system in accordance with safety and technical standards NFPA 70, UL 681, UL 1037, and UL 1076. Configure components within the system with appropriate service points to pinpoint system trouble in less than 20 minutes.

Install all system components, including any equipment that is furnished by the Government, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown on the drawings, and furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

3.1.1 Existing Equipment

Connect to and utilize existing equipment, control signal transmission lines, and devices as shown on the drawings. Any equipment and signal lines that are usable in their original configuration without modification may be reused with Government approval.

Make written requests and obtain approval prior to disconnecting any signal lines and equipment that creates equipment outage. Such work can proceed only after receiving Government approval of these requests. If any device fails after work has commenced on that device, signal, or control line, diagnose the failure and perform any necessary corrections to the equipment. The Government is responsible for maintenance and repair of Government equipment. The Contractor will be held responsible for repair costs due to negligence or abuse of Government equipment on their part.

3.1.2 Enclosure Penetrations

Enclosures are to be penetrated from the bottom unless shown otherwise. Penetrations of interior enclosures having transitions of conduit from interior to exterior, and penetrations of exterior enclosures are to be sealed with rubber silicone sealant to preclude the entry of water. Terminate conduit risers in a hot-dipped galvanized metal cable terminator that is filled with a sealant as recommended by the cable manufacturer, and in a manner that does not damage the cable.

3.1.3 Cable and Wire Runs

Perform required cable and wire routings per NFPA 70 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, ICS 705-1, and as specified. Terminate conduits including flexible metal and armored cable in the sensor or device enclosure. Fit ends of conduit with insulated bushings. Exposed conductors at ends of conduits external to sensors and devices are not acceptable.

3.1.4 Soldering

Soldered electrical connections must use composition Sn60, Type AR or S, for general purposes; use composition Sn62 or Sn63, Type AR or S, for special purposes. Flux must conform to ASTM B32 when Type S solder is used for soldering electrical connections.

3.1.5 Galvanizing

Ferrous metal is to be hot-dip galvanized in accordance with ASTM A123/A123M. Provide screws, bolts, nuts, and other fastenings and supports that are corrosion resistant.

Field welds or brazing on factory galvanized boxes, enclosures, conduits, and so on, are to be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.1.6 Conduits

Install interior conduits in accordance with NFPA 70, Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and ICS 705-1. Install exterior conduits in accordance with NFPA 70, Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION and ICS 705-1.

3.1.7 Underground Cable Installation

Install underground conductors connecting protected structures and objects to the central alarm updating and display unit as direct burial or in conduit as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Coaxial cable cannot be spliced.

3.1.8 Field Applied Painting

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting must be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 ADJUSTMENT, ALIGNMENT, SYNCHRONIZATION, AND CLEANING

a. Clean each system component of dust, dirt, grease, or oil incurred during and after installation or accrued subsequent to installation from other project activities subsequent to installation.

b. Prepare for system activation by manufacturer's recommended procedures for adjustment, alignment, or synchronization.

c. Prepare each component in accordance with appropriate provisions of component installation, operations, and maintenance manuals.

d. Remove large vegetation that may sway in the wind and touch fencing.

e. Adjust sensors so that coverage is overlapping and maximized without mutual interference.

3.3 SYSTEM STARTUP

Do not apply power to the system until after:

a. Set up system equipment items and communications in accordance with manufacturer's instructions.

b. Conduct a system visual inspection to ensure that defective equipment items have not been installed and that there are no loose connections.

c. Test and verify system wiring as correctly connected.

d. Verify system grounding and transient protection systems as properly installed.

e. Verify the correct voltage, phasing, and frequency of the system power supplies.

Satisfaction of the requirements above does not relieve the contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as result of Contractor work or equipment.

3.4 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL

Provide the services of technical representatives who are familiar with all components and installation procedures of the installed system; and are approved by the Contracting Officer. These representatives are to be present on the job site during the preparatory and initial phases of quality control to provide technical assistance. These representatives are also to be available on an as needed basis to provide assistance with follow-up phases of quality control. These technical representatives are to participate in the system testing and validation and provide certification that their respective system portions meet the contractual requirements.

The above requirements supplement the quality control requirements specified elsewhere in the contract.

3.5 ESS SYSTEM TESTING

All ESS Testing requirements are specified in Section 28 08 10 ELECTRICAL SECURITY SYSTEM ACCEPTANCE TESTING.

3.6 NAMEPLATE MOUNTING

Provide nameplate number, location, and letter designation as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or rivets.

-- End of Section --

SECTION 28 31 76

INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S3.2	(2009; R 2014) Method for Measuring the Intelligibility of Speech Over Communication Systems (ASA 85)

EGLIN AFB DESIGN REQUIREMENTS (EGL)

EGL FS & FA Criteria	(2023) Eglin AFB Fire Suppression and Fire Alarm Criteria

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 4	(2018) Standard for Integrated Fire Protection and Life Safety System Testing
NFPA 70	(2023; ERTA 4 2023) National Electrical Code
NFPA 72	(2022) National Fire Alarm and Signaling Code
NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 170	(2021) Standard for Fire Safety and Emergency Symbols

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01	(2016; with Change 6, 2021) Fire Protection Engineering for Facilities
UFC 3-601-02	(2010) Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems
UFC 4-010-06	(2016; with Change 1, 2017) Cybersecurity of Facility-Related Control Systems

UNDERWRITERS LABORATORIES (UL)

UL 268	(2016; Reprint Oct 2019) UL Standard for Safety Smoke Detectors for Fire Alarm Systems
UL 268A	(2008; Reprint Oct 2014) Smoke Detectors for Duct Application
UL 464	(2016; Reprint Sep 2017) UL Standard for Safety Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
UL 497A	(2001; Bul. 2019) UL Standard for Safety Secondary Protectors for Communications Circuits
UL 497B	(2004; Reprint Dec 2012) Protectors for Data Communication Circuits
UL 864	(2014; Reprint May 2020) UL Standard for Safety Control Units and Accessories for Fire Alarm Systems
UL 1283	(2017) UL Standard for Safety Electromagnetic Interference Filters
UL 1449	(2021) UL Standard for Safety Surge Protective Devices
UL 1480	(2016; Reprint Sep 2017) UL Standard for Safety Speakers for Fire Alarm and Signaling Systems, Including Accessories
UL 1638	(2016; Reprint Sep 2017) UL Standard for Safety Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
UL 1971	(2002; Reprint Oct 2008) Signaling Devices for the Hearing Impaired
UL 2017	(2008; Reprint Dec 2018) UL Standard for Safety General-Purpose Signaling Devices and Systems

UL 2572	(2016; Bul. 2018) UL Standard for Safety Mass Notification Systems
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 RELATED SECTIONS

Refer to the following sections for related work and coordination:

Section 21 13 13 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION
Section 23 30 00 HVAC AIR DISTRIBUTION

1.3 SUMMARY

1.3.1 Scope

a. This work includes designing and modifying the existing fire alarm and mass notification (MNS) system as described herein and on the contract drawings. Include system wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, initiating devices, notification appliances, supervising station fire alarm transmitters/mass notification transceiver, and other accessories and miscellaneous items required for a complete operational system even though each item is not specifically mentioned or described. Provide systems complete and ready for operation. Design and installation must comply with UFC 4-010-06, UFC 3-600-01, AFGM 2019-320-02, and EGL FS & FA Criteria .

b. Provide equipment, materials, installation, workmanship, inspection, and testing in strict accordance with NFPA 72, except as modified herein. The system layout on the drawings show the intent of coverage and suggested locations. Final quantity, system layout, and coordination are the responsibility of the Contractor.

c. Each remote fire alarm control unit must be powered from a wiring riser specifically for that use or from a local emergency power panel located on the same floor as the remote fire alarm control unit. Where remote fire control units are provided, equipment for notification appliances may be located in the remote fire alarm control units.

d. The fire alarm and mass notification system must be independent of the building security, building management, and energy/utility monitoring systems other than for control functions.

1.3.2 Qualified Fire Protection Engineer (QFPE)

Services of the QFPE must include:

a. Reviewing SD-02, SD-03, and SD-05 submittal packages for completeness and compliance with the provisions of this specification. Construction (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of, the QFPE. The QFPE must affix their professional engineering stamp with signature to the shop drawings, calculations, and material data sheets, indicating approval prior to submitting the shop drawings to the DFPE.

b. Providing a letter documenting that the SD-02, SD-03, and SD-05 submittal package has been reviewed and noting any outstanding comments.

c. Performing in-progress construction surveillance prior to installation of ceilings (rough-in inspection).

d. Witnessing pre-Government and final Government functional performance testing and performing a final installation review.

e. Signing applicable certificates under SD-07.

1.4 DEFINITIONS

Wherever mentioned in this specification or on the drawings, the equipment, devices, and functions must be defined as follows:

1.4.1 Interface Device

An addressable device that interconnects hard wired systems or devices to an analog/addressable system.

1.4.2 Fire Alarm and Mass Notification Control Unit (FMCU)

A master control unit having the features of a fire alarm control unit (FACU) and an autonomous control unit (ACU) where these units are interconnected to function as a combined fire alarm/mass notification system. The FACU and ACU functions may be contained in a single cabinet or in independent, interconnected, and co-located cabinets.

1.4.3 Remote Fire Alarm and Mass Notification Control Unit

A control unit, physically remote from the fire alarm and mass notification control unit, that receives inputs from automatic and manual fire alarm devices; may supply power to detection devices and interface devices; may provide transfer of power to the notification appliances; may provide transfer of condition to relays or devices connected to the control unit; and reports to and receives signals from the fire alarm and mass notification control unit.

1.4.4 Local Operating Console (LOC)

A unit designed to allow emergency responders and/or building occupants to operate the MNS including delivery of recorded messages and/or live voice announcements, initiate visual, textual visual, and audible appliance operation and other relayed functions.

1.4.5 Terminal Cabinet

A steel cabinet with locking, hinge-mounted door where terminal strips are securely mounted inside the cabinet.

1.4.6 Control Module and Relay Module

Terms utilized to describe emergency control function interface devices as defined by NFPA 72.

1.4.7 Designated Fire Protection Engineer (DFPE)

The DoD fire protection engineer that oversees that Area of Responsibility for that project. This is sometimes referred to as the "cognizant" fire protection engineer. Interpret reference to "authority having jurisdiction" and/or AHJ in referenced standards to mean the Designated Fire Protection Engineer (DFPE). The DFPE may be responsible for review of the contractor submittals having a "G" designation, and for witnessing final inspection and testing.

1.4.8 Qualified Fire Protection Engineer (QFPE)

A QFPE is an individual who is a licensed professional engineer (P.E.), who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) and has relevant fire protection engineering experience.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval.

Shop drawings (SD-02), product data (SD-03) and calculations (SD-05) must be prepared by the fire alarm designer and combined and submitted as one complete package. The QFPE must review the SD-02/SD-03/SD-05 submittal package for completeness and compliance with the Contract provisions prior to submission to the Government. The QFPE must provide a Letter of Confirmation that they have reviewed the submittal package for compliance with the contract provisions. This letter must include their registered professional engineer stamp and signature. Partial submittals and submittals not reviewed by the QFPE will be returned by the Government disapproved without review.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualified Fire Protection Engineer (QFPE); G

Fire alarm system designer; G

Supervisor; G

Technician; G

Installer; G

Test Technician; G

Fire Alarm System Site-Specific Software Acknowledgement; G

SD-02 Shop Drawings

Nameplates; G

Instructions; G

Wiring Diagrams; G

System Layout; G

Notification Appliances; G

Initiating devices; G

Amplifiers; G

Battery Power; G

Voltage Drop Calculations; G

SD-03 Product Data

Fire Alarm and Mass Notification Control Unit (FMCU); G

Local Operating Console (LOC); G

Amplifiers; G

Tone Generators; G

Digitalized voice generators; G

LCD Annunciator; G

Manual Stations; G

Smoke Detectors; G

Duct Smoke Detectors; G

Addressable Interface Devices; G

Addressable Control Modules; G

Isolation Modules; G

Notification Appliances; G

Batteries; G

Battery Chargers; G

Supplemental Notification Appliance Circuit Panels; G

Auxiliary Power Supply Panels; G

Surge Protective Devices; G

Alarm Wiring; G

Back Boxes and Conduit; G

Ceiling Bridges for Ceiling-Mounted Appliances; G

Terminal Cabinets; G

Document Storage Cabinet; G

SD-06 Test Reports

Test Procedures; G

SD-07 Certificates

Verification of Compliant Installation; G

Request for Government Final Test; G

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G

Instruction of Government Employees; G

SD-11 Closeout Submittals

As-Built Drawings

Spare Parts

1.6 SYSTEM OPERATION

Fire alarm system/mass notification system including textual display sign control panel(s), components requiring power, except for the FMCU(s) power supply, must operate on 24 volts DC unless noted otherwise in this section.

The interior fire alarm and mass notification system must be a complete, supervised, noncoded, analog/addressable fire alarm and mass notification system conforming to NFPA 72, UL 864, and UL 2572. Systems meeting UL 2017 only are not acceptable. The system must be activated into the alarm mode by actuation of an alarm initiating device. The system must remain in the alarm mode until the initiating device is reset and the control unit is reset and restored to normal. The system may be placed in the alarm mode by local microphones, LOC, FMCU, or remotely from authorized locations/users.

1.6.1 Alarm Initiating Devices and Notification Appliances (Visual, Voice, Textual)

a. Connect alarm initiating devices to initiating device circuits (IDC) Class "B", or to signaling line circuits (SLC) Class "A" and installed in accordance with NFPA 72.

b. Connect notification appliances to notification appliance circuits (NAC) Class "A.

1.6.2 Functions and Operating Features

The system must provide the following functions and operating features:

a. Power, annunciation, supervision, and control for the system. Addressable systems must be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits with sufficient memory to perform as specified.

b. Visual alarm notification appliances must be synchronized as required by NFPA 72.

c. Electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control unit.

d. An audible and visual trouble signal to activate upon a single break or open condition, or ground fault. The trouble signal must also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, or removal of alarm or supervisory control unit modules. After the system returns to normal operating conditions, the trouble signal must again sound until the trouble is acknowledged. A smoke detector in the process of being verified for the actual presence of smoke must not initiate a trouble condition.

e. A trouble signal silence feature that must silence the audible trouble signal, without affecting the visual indicator.

f. Program capability via switches in a locked portion of the FMCU to bypass the automatic notification appliance circuitsair handler shutdown features. Operation of this programmed action must indicate on the FMCU display as a supervisory or trouble condition.

g. Alarm functions must override trouble or supervisory functions. Supervisory functions must override trouble functions.

h. The system must be capable of being programmed from the control unit keyboard. Programmed information must be stored in non-volatile memory.

i. The system must be capable of operating, supervising, and/or monitoring non-addressable alarm and supervisory devices.

j. There must be no limit, other than maximum system capacity, as to the number of addressable devices that may be in alarm simultaneously.

k. Where the fire alarm/mass notification system is responsible for initiating an action in another emergency control device or system, such as HVAC, the addressable fire alarm relay must be located in the vicinity of the emergency control device.

l. An alarm signal must automatically initiate the following functions:

(1) Transmission of an alarm signal to the remote supervising station.

(2) Visual indication of the device operated on each FMCU, and on the remote annunciator.

(4) Actuation of alarm notification appliances.

(5) Recording of the event electronically in the history log of the FMCU.

m. A supervisory signal must automatically initiate the following functions:

(1) Visual indication of the device operated on each FMCU, and on the remote annunciator.

(3) Transmission of a supervisory signal to a remote supervising

station.

(4) Operation of a duct smoke detector must shut down the appropriate air handler in accordance with NFPA 90A in addition to other requirements of this paragraph and as allowed by NFPA 72.

(5) Recording of the event electronically in the history log of the FMCU.

n. A trouble condition must automatically initiate the following functions:

(1) Visual indication of the device operated on the FMCU, and on the remote annunciator.

(3) Transmission of a trouble signal to a remote supervising station.

(4) Recording of the event electronically in the history log of the FMCU.

o. System control equipment must be programmed to provide a 60-minute to 180-minute delay in transmission of trouble signals resulting from primary power failure.

p. Activation of a LOC pushbutton must activate the audible and visual alarms in the facility. The audible message must be the one associated with the pushbutton activated.

1.7 TECHNICAL DATA AND SITE-SPECIFIC SOFTWARE

Technical data and site-specific software (meaning technical data that relates to computer software) that are specifically identified in this project, and may be required in other specifications, must be delivered, strictly in accordance with the CONTRACT CLAUSES. The fire alarm system manufacturer must submit written confirmation of this contract provision as "Fire Alarm System Site-Specific Software Acknowledgement". Identify data delivered by reference to the specification paragraph against which it is furnished. Data to be submitted must include complete system, equipment, and software descriptions. Descriptions must show how the equipment will operate as a system to meet the performance requirements of this contract. The site-specific software data package must also include the following:

a. Items identified in NFPA 72, titled "Site-Specific Software".

b. Identification of programmable portions of the system equipment and capabilities.

c. Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.

d. Provision of operational software data on all modes of programmable portions for fire alarm and mass notification.

e. Description of Fire Alarm and Mass Notification Control Unit equipment operation.

f. Description of auxiliary and remote equipment operations.

g. Library of application software.

h. Operation and maintenance manuals.

1.8 EXISTING EQUIPMENT

a. Equipment and devices must be compatible and operable with the existing fire alarm/mass notification system and must not impair reliability or operational functions of existing supervising station fire alarm system..

b. Equipment and devices must be compatible and operable with the existing building fire alarm/mass notification system. Equipment must not impair reliability or operational functions of the existing system. The existing building system control unit is Simplex.

1.9 QUALITY ASSURANCE

1.9.1 Submittal Documents

1.9.1.1 Preconstruction Submittals

Within 36 days of contract award but not less than 14 days prior to commencing any work on site, the Contractor must submit the following for review and approval. SD-02, SD-03 and SD-05 submittals received prior to the review and approval of the qualifications of the fire alarm subcontractor and QFPE must be returned disapproved without review. All resultant delays must be the sole responsibility of the Contractor.

1.9.1.2 Shop Drawings

Shop drawings must not be smaller than the Contract Drawings. Drawings must comply with the requirements of NFPA 72 and NFPA 170. Minimum scale for floor plans must be 1/8"=1'.

1.9.1.3 Nameplates

Nameplate illustrations and data to obtain approval by the Contracting Officer before installation.

1.9.1.4 Wiring Diagrams

Three copies of point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between the equipment or systems that are supervised or controlled by the system. Diagrams must show connections from field devices to the FMCU and remote FMCU, initiating circuits, switches, relays and terminals, including pathway diagrams between the control unit and shared communications equipment within the protected premises. Point-to-point wiring diagrams must be job specific and must not indicate connections or circuits not being utilized. Provide complete riser diagrams indicating the wiring sequence of all devices and their connections to the control equipment. Include a color-code schedule for the wiring.

1.9.1.5 System Layout

Three copies of plan view drawing showing device locations, terminal cabinet locations, junction boxes, other related equipment, conduit routing, conduit sizes, wire counts, conduit fill calculations, wire color-coding, circuit identification in each conduit, and circuit layouts for all floors. Indicate candela rating of each visual notification appliance. Indicate the wattage of each speaker. Clearly identify the locations of isolation modules. Indicate the addresses of all devices, modules, relays, and similar. Show/identify all acoustically similar spaces. Indicate if the environment for the FMCU is within its environmental listing (e.g. temperature/humidity).

Provide a complete description of the system operation in matrix format similar to the "Typical Input/Output Matrix" included in the Annex of NFPA 72.

1.9.1.6 Notification Appliances

Calculations and supporting data on each circuit to indicate that there is at least 25 percent spare capacity for notification appliances. Annotate data for each circuit on the drawings.

1.9.1.7 Initiating Devices

Calculations and supporting data on each circuit to indicate that there is at least 25 percent spare capacity for initiating devices. Annotate data for each circuit on the drawings.

1.9.1.8 Amplifiers

Calculations and supporting data to indicate that amplifiers have sufficient capacity to simultaneously drive all notification speakers at tapped settings plus 25 percent spare capacity. Annotate data for each circuit on the drawings.

1.9.1.9 Battery Power

Calculations and supporting data as required in paragraph Battery Power Calculations for alarm, alert, and supervisory power requirements. Calculations including ampere-hour requirements for each system component and each control unit component, and the battery recharging period, must be included on the drawings.

1.9.1.10 Voltage Drop Calculations

Voltage drop calculations for each notification circuit indicating that sufficient voltage is available for proper operation of the system and all components, at a minimum rated voltage of the system operating on batteries. Include the calculations on the system layout drawings.

1.9.1.11 Product Data

Three copies of annotated descriptive data to show the specific model, type, and size of each item. Catalog cuts must also indicate the NRTL listing. The data must be highlighted to show model, size, and options that are intended for consideration. Data must be adequate to demonstrate compliance with all contract requirements. Product data for all equipment must be combined into a single submittal.

Provide an equipment list identifying the type, quantity, make, and model number of each piece of equipment to be provided under this submittal. The equipment list must include the type, quantity, make and model of spare equipment. Types and quantities of equipment submitted must coincide with the types and quantities of equipment used in the battery calculations and those shown on the shop drawings.

1.9.1.12 Operation and Maintenance (O&M) Instructions

Six copies of the Operation and Maintenance Instructions. The O&M Instructions must be prepared in a single volume or in multiple volumes, with each volume indexed, and may be submitted as a Technical Data Package. Manuals must be approved prior to training. The Interior Fire Alarm And Mass Notification System Operation and Maintenance Instructions must include the following:

a. "Manufacturer Data Package five" as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA.

b. Operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual must include the manufacturer's name, model number, service manual, parts list, and preliminary equipment list complete with description of equipment and their basic operating features.

c. Maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals must include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed.

d. Complete procedures for system revision and expansion, detailing both equipment and software requirements.

e. Software submitted for this project on CD/DVD media utilized.

f. Printouts of configuration settings for all devices.

g. Routine maintenance checklist. The routine maintenance checklist must be arranged in a columnar format. The first column must list all installed devices, the second column must state the maintenance activity or state no maintenance required, the third column must state the frequency of the maintenance activity, and the fourth column provided for additional comments or reference. All data (devices, testing frequencies, and similar) must comply with UFC 3-601-02.

h. A final Equipment List must be submitted with the Operating and Maintenance (O&M) manual.

1.9.1.13 As-Built Drawings

The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final Government test of the system. At least one set of the as-built (marked-up) drawings must be provided at the time of, or prior to the final Government test.

1.9.2 Qualifications

1.9.2.1 Fire Alarm System Designer

The fire alarm system designer must be certified as a Level III (minimum) Technician by National Institute for Certification in Engineering

Technologies (NICET) in the Fire Alarm Systems subfield of Fire Protection Engineering Technology or meet the qualifications for a QFPE.

1.9.2.2 Supervisor

A NICET Level III fire alarm technician must supervise the installation of the fire alarm/mass notification system. The fire alarm technicians supervising the installation of equipment must be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.9.2.3 Technician

Fire alarm technicians with a minimum of four years of experience must be utilized to install and terminate fire alarm/mass notification devices, cabinets and control units. The fire alarm technicians installing the equipment must be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.9.2.4 Installer

Fire alarm installer with a minimum of two years of experience utilized to assist in the installation of fire alarm/mass notification devices, cabinets and control units. A licensed electrician must be allowed to install wire, cable, conduit and backboxes for the fire alarm system/mass notification system. The fire alarm installer must be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.9.2.5 Test Technician

Fire alarm technicians with a minimum of eight years of experience and NICET Level III utilized in testing and certification of the installation of the fire alarm/mass notification devices, cabinets and control units. The fire alarm technicians testing the equipment must be factory trained in the installation, adjustment, testing, and operation of the equipment installed as part of this project.

1.9.2.6 Manufacturer

Components must be of current design and must be in regular and recurrent production at the time of installation. Provide design, materials, and devices for a protected premises fire alarm system, complete, conforming to NFPA 72, except as specified herein.

1.9.3 Regulatory Requirements

Equipment and material must be listed or approved. Listed or approved, as used in this section, means listed, labeled or approved by a Nationally Recognized Testing Laboratory (NRTL) such as UL Fire Prot Dir or FM APP GUIDE. The omission of these terms under the description of any item of equipment described must not be construed as waiving this requirement. All listings or approvals by testing laboratories must be from an existing ANSI or UL published standard. The recommended practices stated in the manufacturer's literature or documentation must be considered as mandatory requirements.

1.10 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants.

1.11 MAINTENANCE

1.11.1 Spare Parts

Furnish the following spare parts in the manufacturers original unopened containers:

a. Five complete sets of system keys.

b. Two of each type of fuse required by the system.

c. One manual stations.

d. One of each type of detector installed.

e. One of each type of detector base and head installed.

f. Two of each type of audible and visual alarm device installed.

g. One of each type of addressable monitor module installed.

h. One of each type of addressable control module installed.

i. One low voltage and one 120 VAC surge protective device.

j. Two spare reams of paper for the system printer, plus sufficient paper for testing.

o. Two spare printer ribbons.

1.11.2 Special Tools

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment must be furnished to the Contracting Officer, prior to the instruction of Government employees.

PART 2 PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENT

All fire alarm and mass notification equipment must be listed for use under the applicable reference standards. Interfacing of UL 864 or similar approved industry listing with Mass Notification equipment listed to UL 2572 must be done in a laboratory listed configuration, if the software programming features cannot provide a listed interface control.

2.2 MATERIALS AND EQUIPMENT

2.2.1 Standard Products

Provide materials, equipment, and devices that have been tested by a nationally recognized testing laboratory and listed for fire protection service when so required by NFPA 72 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for any particular classification of materials. Material and equipment must be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening.

2.2.2 Nameplates

Major components of equipment must have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new name plate permanently affixed to the item or equipment. Major components include, but are not limited to, the following:

a. FMCU

Nameplates must be etched metal or plastic, permanently attached by screws to control units or adjacent walls.

2.2.3 Keys

Keys and locks for equipment, control units and devices must be identical.

2.2.4 Instructions

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the FMCU. The card must show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions must also include procedures for operating live voice microphones. The instructions and their mounting location must be approved by the Contracting Officer before being posted.

2.3 FIRE ALARM AND MASS NOTIFICATION CONTROL UNIT

Provide a complete fire alarm and mass notification control unit (FMCU) fully enclosed in a lockable steel cabinet as specified herein. Operations required for testing or for normal care, maintenance, and use of the system must be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control unit, the unit cabinets must match exactly. If more than a single unit is required, and is located in the lobby/entrance, notify the Contracting Officer's Designated Representative (COR), prior to installing the equipment. The system must be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling such as waterflow switches, valve supervisory switches, fire pump monitoring, independent smoke detection systems, relays for output function actuation.

a. Each control unit must provide power, supervision, control, and logic for the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit must be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each control unit with supervisory functions for power failure, internal component placement, and operation.

b. Visual indication of alarm, supervisory, or trouble initiation on the FMCU must be by liquid crystal display or similar means with a minimum of 80 characters. The mass notification control unit must have the capability of temporarily deactivate the fire alarm audible notification appliances while delivering voice messages.

c. Provide secure operator console for initiating recorded messages, strobes and displays; and for delivering live voice messages. Provide capacity for at least eight prerecorded messages. Provide the ability to automatically repeat prerecorded messages. Provide a secure microphone for delivering live messages. Provide adequate discrete outputs to temporarily deactivate fire alarm audible notification, initiate/synchronize strobes and initiate textual visual notification appliances. Provide a complete set of self-diagnostics for controller and appliance network. Provide local diagnostic information display and local diagnostic information and system event log file.

2.3.1 Cabinet

Install control unit components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of control units as well as field wiring. The cabinet must be a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions. The enclosure must be identified by an engraved phenolic resin nameplate. Lettering on the nameplate must say "Fire Alarm and Mass Notification control unit" and must not be less than 1-inch high. Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches.

2.3.2 Silencing Switches

2.3.2.1 Alarm Silencing Switch

Provide an alarm silencing switch at the FMCU that must silence the audible and visual notification appliances. Subsequent activation of initiating devices must cause the notification appliances to re-activate.

2.3.2.2 Supervisory/Trouble Silencing Switch

Provide supervisory and trouble silencing switch(es) that must silence the audible trouble and supervisory signal(s), but not extinguish the visual indicator. This switch must be overridden upon activation of a subsequent supervisory or trouble condition. Audible trouble indication must resound automatically every 24 hours after the silencing feature has been operated if the supervisory or trouble condition still exists.

2.3.3 Non-Interfering

Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Initiating devices must be manually reset by switch from the FMCU after the initiating device or devices have been restored to normal.

2.3.4 Audible Notification System

The Audible Notification System must comply with the requirements of NFPA 72 for Emergency Voice/Alarm Communications System requirements, except as specified herein. The system must be a one-way, multi-channel voice notification system incorporating user selectability of a minimum eight distinct sounds for tone signaling, and the incorporation of a voice module for delivery of recorded messages. Audible appliances must produce a three-pulse temporal pattern for three cycles followed by a voice message that is repeated until the control unit is reset or silenced. For carbon monoxide detector activation, audible appliances must produce a four-pulse temporal pattern for three cycles followed by a voice message that is repeated until the control unit is reset or silenced. Automatic messages must be broadcast through speakers throughout the building/facility but not in stairs or elevator cabs. A live voice message must override the automatic audible output through use of a microphone input at the control unit or the LOC.

a. When using the microphone, live messages must be broadcast or all call. The system must be capable of operating all speakers at the same time.

b. The microprocessor must actively interrogate circuitry, field wiring, and digital coding necessary for the immediate and accurate rebroadcasting of the stored voice data into the appropriate amplifier input. Loss of operating power, supervisory power, or any other malfunction that could render the digitalized voice module inoperative must automatically cause the three-pulse temporal pattern to take over all functions assigned to the failed unit in the event an alarm is activated.

2.3.4.1 Outputs and Operational Modules

All outputs and operational modules must be fully supervised with on-board diagnostics and trouble reporting circuits. Provide form "C" contacts for system alarm and trouble conditions. Provide circuits for operation of auxiliary appliance during trouble conditions. During a Mass Notification event, the control unit must not generate nor cause any trouble alarms to be generated with the Fire Alarm system.

2.3.4.2 Mass Notification

a. The system must have the capability of utilizing an LOC with redundant controls of the FMCU. Notification Appliance Circuits (NAC) must be provided for the activation of strobe appliances. Audio output must be selectable for line level. A hand-held microphone must be provided and, upon activation, must take priority over any tone signal, recorded message or PA microphone operation in progress, while maintaining the strobe NAC circuit activation.

b. The Mass Notification functions must override the manual or automatic fire alarm notification. Other fire alarm functions including transmission of a signal(s) to the fire department must remain operational. When a mass notification announcement is disengaged and a fire alarm condition still exists, the audible and visual notification appliances must resume activation for alarm conditions. The fire alarm message must be of lower priority that all other messages (except any "test" messages) and must not override any other messages.

c. Messages must be recorded professionally utilizing standard industry methods, in a professional female voice. Message and tone volumes must both be at the same decibel level. Messages recorded from the system microphone must not be accepted. A 1000 Hz tone (as required by NFPA 72) must precede messages

d. Auxiliary Input Module must be designed to be an outboard expansion module to either expand the number of optional LOC's, or allow a telephone interface.

2.3.5 Memory

Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors, or other age-dependent devices must not be considered as equal to non-volatile processors, PROMS, or EPROMS.

2.3.6 Field Programmability

Provide control units and control units that are fully field programmable for both input and output of control, initiation, notification, supervisory, and trouble functions. The system program configuration must be menu driven. System changes must be password protected. Any proprietary equipment and proprietary software needed by qualified technicians to implement future changes to the fire alarm system must be provided as part of this contract.

2.3.7 Input/Output Modifications

The FMCU must contain features that allow the bypassing of input devices from the system or the modification of system outputs. These control features must consist of a control unit mounted keypad and a keyboard. Any bypass or modification to the system must indicate a trouble condition on the FMCU.

2.3.8 Resetting

Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory or trouble condition on the system still exists.

2.3.9 Walk Test

The FMCU must have a walk test feature. When using this feature, operation of initiating devices must result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated in the history log, but no other outputs occur.

2.3.10 History Logging

The control unit must have the ability to store a minimum of 400 events in a log. These events must be stored in a battery-protected memory and must remain in the memory until the memory is downloaded or cleared manually. Resetting of the control unit must not clear the memory.

2.3.11 Manual Access

An operator at the control unit, having a proper access level, must have the capability to manually access the following information for each initiating device.

a. Primary status.

b. Device type.

c. Present average value.

d. Present sensitivity selected.

e. Detector range (normal, dirty).

2.4 LOCAL OPERATING CONSOLES (LOC)

2.4.1 General

The LOC must consist of a remote microphone station incorporating a push-to-talk (PTT) hand-held microphone and system status indicators. The LOC must have the capability of being utilized to activate prerecorded messages. The unit must incorporate microphone override of any tone generation or recorded messages. The unit must be fully supervised from the FMCU. The housing for the LOC must not be lockable.

2.4.2 Multiple LOCs

When an installation has more than one LOC, the LOCs must be programmed to allow only one LOC to be available for paging or messaging at a time. Once one LOC becomes active, all other LOC's will have an indication that the system is busy (Amber Busy Light) and cannot be used at that time. This is to avoid two messages being given at the same time. It must be possible to override or lockout the LOC's from the FMCU.

2.5 AMPLIFIERS, PREAMPLIFIERS, TONE GENERATORS

Any amplifiers, preamplifiers, tone generators, digitalized voice generators, and other hardware necessary for a complete, operational, textual audible circuit conforming to NFPA 72 must be housed in a remote FMCU, terminal cabinet, or in the FMCU. Individual amplifiers must be 100 watts maximum.

2.5.1 Operation

The system must automatically operate and control all building speakers.

2.5.2 Construction

Amplifiers must utilize computer grade solid state components and must be provided with output protection devices sufficient to protect the amplifier against any transient up to 10 times the highest rated voltage in the system.

2.5.3 Inputs

Equip each system with separate inputs for the tone generator, digitalized voice driver and control unit mounted microphone. Microphone inputs must be of the low impedance, balanced line type. Both microphone and tone generator input must be operational on any amplifier.

2.5.4 Tone Generator

The tone generator must produce a three-pulse temporal pattern and must be constantly repeated until interrupted by either the digitalized voice message, the microphone input, or the alarm silence mode as specified. The tone generator must be single channel with an automatic backup generator per channel such that failure of the primary tone generator causes the backup generator to automatically take over the functions of the failed unit and also causes transfer of the common trouble relay. The tone generator must be provided with securely attached labels to identify the component as a tone generator and to identify the specific tone it produces.

2.5.5 Protection Circuits

Each amplifier must be constantly supervised for any condition that could render the amplifier inoperable at its maximum output. Failure of any component must cause illumination of a visual "amplifier trouble" indicator on the control unit, appropriate logging of the condition in the history log, and other actions for trouble conditions as specified.

2.6 REMOTE ANNUNCIATOR

2.6.1 LCD Annunciator

Provide a semi-recessed mounted annunciator that includes an LCD display. The display must indicate the device in trouble/alarm or any supervisory device. Display the device name, address, and actual building location. The remote annunciator must duplicate functions of the FMCU for message display, fire alarm, supervisory alarm, and trouble conditions, visual and audible notification, and system reset functions. Remote annunciator must require the use of a key for accessing the reset, control and other functions.

A building floor plan must be provided and mounted (behind Plexiglass or similar protective material) at the annunciator location. The floor plan must indicate all rooms by name and number including the locations of stairs and elevators. The floor plan must show all devices and their programmed address to facilitate identification of their physical location from the LCD display information.

2.7 MANUAL STATIONS

Provide metal or plastic, surface mounted, double-action, addressable manual stations, that are not subject to operation by jarring or vibration. Stations must be equipped with screw terminals for each conductor. Stations that require the replacement of any portion of the device after activation are not permitted. Stations must be finished in red with molded raised lettering operating instructions of contrasting color. The use of a key must be required to reset the station.

2.8 SMOKE DETECTORS

2.8.1 Spot Type Detectors

Provide addressable photoelectric smoke detectors as follows:

a. Provide analog/addressable photoelectric smoke detectors utilizing the photoelectric light scattering principle for operation in accordance with UL 268. Smoke detectors must be listed for use with the FMCU.

b. Provide self-restoring type detectors that do not require any readjustment after actuation at the FMCU to restore them to normal operation. The detector must have a visual indicator to show actuation.

c. Vibration must have no effect on the detector's operation. Protect the detection chamber with a fine mesh metallic screen that prevents the entrance of insects or airborne materials. The screen must not inhibit the movement of smoke particles into the chamber.

d. Provide twist lock bases with screw terminals for each conductor. The detectors must maintain contact with their bases without the use of springs.

e. The detector address must identify the particular unit, its location within the system, and its sensitivity setting. Detectors must be of the low voltage type rated for use on a 24 VDC system.

2.8.2 Duct Smoke Detectors

Duct-mounted addressable photoelectric smoke detectors must consist of a smoke detector, as specified in paragraph Spot Type Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry must be mounted in a metallic or plastic enclosure exterior to the duct. Detectors must be listed for operation over the complete range of air velocities, temperature and humidity expected at the detector when the air-handling system is operating. Detectors must be powered from the FMCU.

a. Sampling tubes must run the full width of the duct. The duct detector package must conform to the requirements of NFPA 90A, UL 268A, and must be listed for use in air-handling systems. The control functions, operation, reset, and bypass must be controlled from the FMCU.

b. Lights to indicate the operation and alarm condition must be visible and accessible with the unit installed and the cover in place. Remote indicators must be provided where required by NFPA 72. Remote indicators as well as the affected fan units must be properly identified in etched plastic placards.

c. Detectors must provide for control of auxiliary contacts that provide control, interlock, and shutdown functions. Auxiliary contacts provide for this function must be located within 3 feet of the controlled circuit or appliance. The auxiliary contacts must be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

2.9 ADDRESSABLE INTERFACE DEVICES

The initiating device being monitored must be configured as a Class "B" initiating device circuits. The module must be listed as compatible with the control unit. The module must provide address setting means compatible with the control unit's SLC supervision and store an internal identifying code. Monitor module must contain an integral LED that flashes each time the monitor module is polled and is visible through the device cover plate. Pull stations with a monitor module in a common backbox are not required to have an LED. Modules must be listed for the environmental conditions in which they will be installed.

2.10 ADDRESSABLE CONTROL MODULES

The control module must be capable of operating as a relay (dry contact form C) for interfacing the control unit with other systems, and to control door holders or initiate elevator fire service. The module must be listed as compatible with the control unit. The indicating device or the external load being controlled must be configured as Class A notification appliance circuits. The system must be capable of supervising, audible, visual and dry contact circuits. The control module must have both an input and output address. The supervision must detect a short on the supervised circuit and must prevent power from being applied to the circuit. The control module must provide address setting means compatible with the control unit's SLC supervision and store an internal identifying code. The control module must contain an integral LED that flashes each time the control module is polled and is visible through the device cover plate. Control Modules must be listed for the environmental conditions in which they will be installed.

2.11 ISOLATION MODULES

a. Provide isolation modules to subdivide each signaling line circuit into groups of not more than 20 addressable devices between adjacent isolation modules.

b. Isolation modules must provide short circuit isolation for signaling line circuit wiring.

c. Power and communications must be supplied by the SLC and must report faults to the FMCU.

d. After the wiring fault is repaired, the fault isolation modules must test the lines and automatically restore the connection.

2.12 NOTIFICATION APPLIANCES

2.12.1 Audible Notification Appliances

Audible appliances must conform to the applicable requirements of UL 464. Appliances must be connected into notification appliance circuits. Surface mounted audible appliances must be painted red. Recessed audible appliances must be installed with a grill that is painted red.

2.12.1.1 Speakers

a. Speakers must conform to the applicable requirements of UL 1480. Speakers must have six different sound output levels and operate with audio line input levels of 70.7 VRMs and 25 VRMs, by means of selectable tap settings. Interior speaker tap settings must include taps of 1/4, 1/2, 1, and 2 watt, at a minimum. Exterior speakers must also be multi-tapped with no more than 15 watt maximum setting. Speakers must incorporate a high efficiency speaker for maximum output at minimum power across a frequency range of 400 Hz to 4,000 Hz, and must have a sealed back construction. Speakers must be capable of installation on standard 4-inch square electrical boxes. Where speakers and strobes are provided in the same location, they may be combined into a single wall mounted unit. All inputs must be polarized for compatibility with standard reverse polarity supervision of circuit wiring via the FMCU.

b. Provide speaker mounting plates constructed of cold rolled steel having a minimum thickness of 16 gage or molded high impact plastic and equipped with mounting holes and other openings as needed for a complete installation. Fabrication marks and holes must be ground and finished to provide a smooth and neat appearance for each plate. Each plate must be primed and painted.

c. Speakers must utilize screw terminals for termination of all field wiring.

2.12.2 Visual Notification Appliances

Visual notification appliances must conform to the applicable requirements of UL 1638, UL 1971 and conform to the Architectural Barriers Act (ABA). Visual Notification Appliances must have clear high intensity optic lens, xenon flash tubes, or light emitting diode (LED) and be marked "Alert" in letters of contrasting color. The light pattern must be dispersed so that it is visible above and below the strobe and from a 90 degree angle on both sides of the strobe. Strobe flash rate must be 1 flash per second and a minimum of 15 candela based on the UL 1971 test. Strobe must be surface mounted.

2.13 ELECTRIC POWER

2.13.1 Primary Power

Power must be 120 VAC 60 Hz service for the FMCU from the AC service to the building in accordance with NFPA 72.

2.14 SECONDARY POWER SUPPLY

Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power must be automatic and must not cause transmission of a false alarm.

2.14.1 Batteries

Provide sealed, maintenance-free, sealed lead acid batteries as the source for emergency power to the FMCU. Batteries must contain suspended electrolyte. The battery system must be maintained in a fully charged condition by means of a solid state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.

2.14.1.1 Capacity

Battery size must be the greater of the following two capacities. This capacity applies to every control unit associated with this system, including supplemental notification appliance circuit panels, auxiliary power supply panels, fire alarm transmitters, and Base-wide mass notification transceivers. When determining the required capacity under alarm condition, visual notification appliances must include both textual and non-textual type appliances.

a. Sufficient capacity to operate the fire alarm system under supervisory and trouble conditions, including audible trouble signal devices for 48 hours and audible and visual signal devices under alarm conditions for an additional 15 minutes.

b. Sufficient capacity to operate the mass notification for 60 minutes after loss of AC power.

2.14.1.2 Battery Power Calculations

a. Verify that battery capacity exceeds supervisory and alarm power requirements for the criteria noted in the paragraph "Capacity" above.

(1) Substantiate the battery calculations for alarm and supervisory power requirements. Include ampere-hour requirements for each system component and each control unit component, and compliance with UL 864.

(2) Provide complete battery calculations for both the alarm and supervisory power requirements. Submit ampere-hour requirements for each system component with the calculations.

(3) Provide voltage drop calculations to indicate that sufficient voltage is available for proper operation of the system and all components. Calculations must be performed using the minimum rated voltage of each component.

b. For battery calculations assume a starting voltage of 24 VDC for starting the calculations to size the batteries. Calculate the required Amp-Hours for the specified standby time, and then calculate the required Amp-Hours for the specified alarm time. Using 20.4 VDC as starting voltage, perform a voltage drop calculation for circuits containing device and/or appliances remote from the power sources.

2.14.2 Battery Chargers

Provide a solid state, fully automatic, variable charging rate battery charger. The charger must be capable of providing 120 percent of the connected system load and must maintain the batteries at full charge. In the event the batteries are fully discharged (20.4 Volts dc), the charger must recharge the batteries back to 95 percent of full charge within 48 hours after a single discharge cycle as described in paragraph CAPACITY above. Provide pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided.

2.15 SURGE PROTECTIVE DEVICES

Surge protective devices must be provided to suppress all voltage transients which might damage fire alarm control unit components. Systems having circuits located outdoors, communications equipment must be protected against surges induced on any signaling line circuit. Cables and conductors, that serve as communications links, must have surge protection circuits installed at each end. The surge protective device must wire in series to the power supply of the protected equipment with screw terminations. Line voltage surge arrestor must be installed directly adjacent to the power panel where the FMCU breaker is located.

a. Surge protective devices for nominal 120 VAC must be UL 1449 listed with a maximum 500 volt suppression level and have a maximum response time of 5 nanoseconds. The surge protective device must also meet IEEE C62.41.1 and IEEE C62.41.2 category B tests for surge capacity. The surge protective device must feature multi-stage construction and be provided with a long-life indicator lamp (either light emitting diode or neon) which extinguishes upon failure of protected components. Any unit fusing must be externally accessible.

b. Surge protective devices for nominal 24 VAC, fire alarm telephone dialer, or ethernet connection must be UL 497B listed, meet IEEE C62.41.1 and have a maximum response time of 1-nanosecond. The surge protective device must feature multi-stage construction and be self-resetting. The surge protective device must be a base and plug style. The base assembly must have screw terminals for fire alarm wiring. The base assembly must accept "plug-in" surge protective module.

c. All surge protective devices (SPD) must be the standard product of a single manufacturer and be equal or better than the following:

(1) For 120 VAC nominal line voltage: UL 1449 and UL 1283 listed, series connected 120 VAC, 20A rated, surge protective device in a NEMA 4x enclosure. Minimum 50,000 amp surge current rating with EMI/RFI filtering and a dry contact circuit for remote monitoring of surge protection status.

(2) For 24-volt nominal line voltage: UL 497B listed, series connected low voltage, 24-volt, 5A rated, loop circuit protector, base and replaceable module.

(3) For alarm telephone dialers: UL 497A listed, series connected, 130-volt, 150 mA rated with self-resetting fuse, dialer circuit protector with modular plug and play.

(4) For IP-DACTS: UL 497B listed, series connected, 6.4-volt, 1.5A rated with 20 kA/pair surge current, data network protector with modular plug and play.

2.16 WIRING

Provide wiring materials under this section as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM with the additions and modifications specified herein.

2.16.1 Alarm Wiring

IDC and SLC wiring must be solid copper cable in accordance with the manufacturers requirements. Copper signaling line circuits and initiating device circuit field wiring must be No. 18 AWG size conductors at a minimum. Visual notification appliance circuit conductors, that contain audible alarm appliances, must be copper No. 14 AWG size conductors at a minimum. Speaker circuits must be copper No. 16 AWG size twisted and shielded conductors at a minimum. Wiring for textual notification appliance circuits must be in accordance with manufacturer's requirements but must be supervised by the FMCU. Wire size must be sufficient to prevent voltage drop problems. Circuits operating at 24 VDC must not operate at less than the listed voltages for the detectors and/or appliances. Power wiring, operating at 120 VAC minimum, must be a minimum No. 12 AWG solid copper having similar insulation. Acceptable power-limited cables are FPL, FPLR or FPLP as appropriate with red colored covering. Nonpower-limited cables must comply with NFPA 70.

2.17 SYSTEM MONITORING

2.17.1 Valves

Each valve affecting the proper operation of a fire protection system, including automatic sprinkler control valves, sprinkler service entrance valve, isolating valves for pressure type waterflow or supervision switches, and valves at backflow preventers, whether supplied under this contract or existing, must be electrically monitored to ensure its proper position. Provide each tamper switch with a separate address, unless they are within the same room, then a maximum of five can use the same address.

PART 3 EXECUTION

3.1 VERIFYING ACTUAL FIELD CONDITIONS

Before commencing work, examine all adjoining work on which the contractor's work is in any way dependent for perfect workmanship according to the intent of this specification section, and report to the Contracting Officer's Representative any condition which prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.

3.2 INSTALLATION

3.2.1 Fire Alarm and Mass Notification Control Unit (FMCU)

Locate the FMCU where indicated on the drawings. Surface mount the enclosure with the top of the cabinet 6 feet above the finished floor or center the cabinet at 5 feet, whichever is lower. Conductor terminations must be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection must be permanently mounted in the FMCU. Locate the document storage cabinet adjacent to the FMCU unless the Contracting Officer directs otherwise.

3.2.2 Battery Cabinets

When batteries will not fit in the FMCU, locate battery cabinets below or adjacent to the FMCU. Battery cabinets must be installed at an accessible location when standing at floor level. Battery cabinets must not be installed lower than 12 inches above finished floor, measured to the bottom of the cabinet, nor higher than 36 inches above the floor, measured to the top of the cabinet. Installing batteries above drop ceilings or in inaccessible locations is prohibited. Battery cabinets must be large enough to accommodate batteries and also to allow ample gutter space for interconnection of control units as well as field wiring. The cabinet must be provided in a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions.The cabinet must be identified by an engraved phenolic resin nameplate. Lettering on the nameplate must indicate the control unit(s) the batteries power and must not be less than 1-inch high.

3.2.3 Manual Stations

Locate manual stations as required by NFPA 72 and as indicated on the drawings. Mount stations so they are located no farther than 5 feet from the exit door they serve, measured horizontally.

3.2.4 Notification Appliances

a. Locate notification appliance devices as required by NFPA 72 and to meet the intelligibility requirements. Where two or more visual notification appliances are located in the same room or corridor or field of view, provide synchronized operation. Devices must use screw terminals for all field wiring. Audible and visual notification appliances mounted in acoustical ceiling tiles must be centered in the tiles plus or minus 2 inches.

b. Audible and visual notification appliances mounted on the exterior of the building, within unconditioned spaces, or in the vicinity of showers must be listed weatherproof appliances installed on weatherproof backboxes.

c. Speakers must not be located in close proximity to the FMCU or LOC so as to cause feedback when the microphone is in use.

3.2.5 Smoke Detectors

Locate detectors as required by NFPA 72 and their listing on a 4-inch mounting box. Smoke detectors are permitted to be on the wall no lower than12 inches from the ceiling with no minimum distance from the ceiling. Install smoke detectors no closer than 3 feet from air handling supply diffusers. Detectors installed in acoustical ceiling tiles must be centered in the tiles plus or minus 2 inches.

3.2.6 LCD REMOTE Annunciator

Locate the LCD annunciator as required by NFPA 72 .

3.2.7 Local Operating Console (LOC)

Locate the LOC(s) as required by NFPA 72 and as indicated.

3.2.8 Ceiling Bridges

Provide ceiling bridges for ceiling-mounted appliances. Ceiling bridges must be as recommended/required by the manufacturer of the ceiling-mounted notification appliance.

3.3 SYSTEM FIELD WIRING

3.3.1 Wiring within Cabinets, Enclosures, and Boxes

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 must be connected to screw-type terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. The use of wire nuts or similar devices is prohibited. Wiring to conform with NFPA 70.

Indicate the following in the wiring diagrams:

a. Point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between the equipment or systems that are supervised or controlled by the system. Diagrams must show connections from field devices to the FMCU and remote fire alarm/mass notification control units, initiating circuits, switches, relays and terminals.

b. Complete riser diagrams indicating the wiring sequence of devices and their connections to the control equipment. Include a color code schedule for the wiring. Include floor plans showing the locations of devices and equipment.

3.3.2 Terminal Cabinets

Provide a terminal cabinet at the base of any circuit riser, on each floor at each riser, and where indicated on the drawings. Terminal size must be appropriate for the size of the wiring to be connected. Conductor terminations must be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection must be permanently mounted in the terminal cabinet. Minimum size is 8 inches by 8 inches. Only screw-type terminals are permitted. Provide an identification label, that displays "FIRE ALARM TERMINAL CABINET" with 2-inch lettering, on the front of the terminal cabinet.

3.3.3 Alarm Wiring

a. Voltages must not be mixed in any junction box, housing or device, except those containing power supplies and control relays.

b. Utilize shielded wiring where recommended by the manufacturer. For shielded wiring, ground the shield at only one point, in or adjacent to the FMCU.

c. Pigtail or T-tap connections to signal line circuits, initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited.

d. Color coding is required for circuits and must be maintained throughout the circuit. Conductors used for the same functions must be similarly color coded. Conform wiring to NFPA 70.

e. Pull all conductors splice free. The use of wire nuts, crimped connectors, or twisting of conductors is prohibited. Where splices are unavoidable, the location of the junction box or pull box where they occur must be identified on the as-built drawings. The number and location of splices must be subject to approval by the Designated Fire Protection Engineer (DFPE).

3.3.4 Back Boxes and Conduit

In addition to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, provide all wiring in rigid metal conduit or intermediate metal conduit unless specifically indicated otherwise. Minimum conduit size must be 3/4-inch in diameter. Do not use electrical non-metallic tubing (ENT) or flexible non-metallic tubing and associated fittings.

a. Galvanized rigid steel (GRS) conduit must be utilized where exposed to weather, where subject to physical damage, and where exposed on exterior of buildings. Intermediate metal conduit (IMC) may be used in lieu of GRS as allowed by NFPA 70.

b. Electrical metallic tubing (EMT) is permitted above suspended ceilings or exposed where not subject to physical damage. Do not use EMT underground, encased in concrete, mortar, or grout, in hazardous locations, where exposed to physical damage, outdoors or in fire pump rooms. Use die-cast compression connectors.

c. For rigid metallic conduit (RMC), only threaded type fitting are permitted for wet or damp locations.

d. Flexible metal conduit is permitted for initiating device circuits 6 feet in length or less. Flexible metal conduit is prohibited for notification appliance circuits and signaling line circuits. Use liquid tight flexible metal conduit in damp and wet locations.

e. Schedule 40 (minimum) polyvinyl chloride (PVC) is permitted where conduit is routed underground or underground below floor slabs. Convert non-metallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before turning up through floor slab.

f. Exterior wall penetrations must be weathertight. Conduit must be sealed to prevent the infiltration of moisture.

g. For Class "A" or "X" circuits with conductor lengths of 10 feet or less, the conductors must be permitted to be installed in the same raceway in accordance with NFPA 72.

3.3.5 Conductor Terminations

Labeling of conductors at terminal blocks in terminal cabinets, FMCU, and remote FMCU and the LOC must be provided at each conductor connection. Each conductor or cable must have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet, FMCU, and remote FMCU must contain a laminated drawing that indicates each conductor, its label, circuit, and terminal. The laminated drawing must be neat, using 12 point lettering minimum size, and mounted within each cabinet, control unit, or unit so that it does not interfere with the wiring or terminals. Maintain existing color code scheme where connecting to existing equipment.

3.4 CONNECTION OF NEW SYSTEM

The following new system connections must be made during the last phase of construction, at the beginning of the pre-Government tests. New system connections must include:

a. Connection of new relays to existing magnetic door hold-open devices.

b. Connection of new elevator recall relays to existing wiring and conduit.

c. Connection of new system transmitter to existing installation fire reporting system.

Once these connections are made, system must be left energized. Report immediately to the Contracting Officer, coordination and field problems resulting from the connection of the above components.

3.5 PAINTING

a. In unfinished areas all conduit, junction/back boxes, covers, and couplings, when provided, must be factory painted red (e.g., above ceilings, mechanical rooms, concealed spaces, etc.).

b. In finished areas, paint exposed electrical conduit (serving fire alarm equipment), fire alarm conduit, surface metal raceways, junction boxes, and electrical boxes to match adjacent finishes. The inside cover of the junction box must be identified as "Fire Alarm" and the conduit must have painted red bands 3/4-inch wide at 10-foot centers and at each side of a floor, wall, or ceiling penetration.

3.6 FIELD QUALITY CONTROL

3.6.1 Test Procedures

Submit detailed test procedures, prepared and signed by the NICET Level III Fire Alarm Technician, and the representative of the installing company, and reviewed by the QFPE 30 days prior to performing system tests. Detailed test procedures must list all components of the installed system such as initiating devices and circuits, notification appliances and circuits, signaling line devices and circuits, control devices/equipment, batteries, transmitting and receiving equipment, power sources/supply, annunciators, special hazard equipment, emergency communication equipment, interface equipment, and surge protective devices. Test procedures must include sequence of testing, time estimate for each test, and sample test data forms. The test data forms must be in a check-off format (pass/fail with space to add applicable test data; similar to the forms in NFPA 72 and NFPA 4.) The test procedures and accompanying test data forms must be used for the pre-Government testing and the Government testing. The test data forms must record the test results and must:

a. Identify the NFPA Class of all Initiating Device Circuits (IDC), and Notification Appliance Circuits (NAC), Voice Notification System Circuits (NAC Audio), and Signaling Line Circuits (SLC).

b. Identify each test required by NFPA 72 Test Methods and required test herein to be performed on each component, and describe how these tests must be performed.

c. Identify each component and circuit as to type, location within the facility, and unique identity within the installed system. Provide necessary floor plan sheets showing each component location, test location, and alphanumeric identity.

d. Identify all test equipment and personnel required to perform each test (including equipment necessary for smoke detector testing. The use of magnets is not permitted.

e. Provide space to identify the date and time of each test. Provide space to identify the names and signatures of the individuals conducting and witnessing each test.

3.6.2 Pre-Government Testing

3.6.2.1 Verification of Compliant Installation

Conduct inspections and tests to ensure that devices and circuits are functioning properly. Tests must meet the requirements of paragraph entitled "Minimum System Tests" as required by NFPA 72. The contractor and an authorized representative from each supplier of equipment must be in attendance at the pre-Government testing to make necessary adjustments. After inspection and testing is complete, provide a signed Verification of Compliant Installation letter by the QFPE that the installation is complete, compliant with the specification and fully operable. The letter must include the names and titles of the witnesses to the pre-Government tests. Provide all completion documentation as required by NFPA 72 including all referenced annex sections and the test reports noted below.

a. NFPA 72 Record of Completion.

b. NFPA 72 Record of Inspection and Testing.

c. Fire Alarm and Emergency Communication System Inspection and Testing Form.

d. Audibility test results with marked-up test floor plans.

e. Intelligibility test results with marked-up floor plans.

f. Documentation that all tests identified in the paragraph "Minimum System Tests" are complete.

3.6.2.2 Request for Government Final Test

When the verification of compliant installation has been completed, submit a formal request for Government final test to the Contracting Officer's Representative (COR). Government final testing will not be scheduled until the DFPE has received copies of the request for Government final testing and Verification of Compliant Installation letter with all required reports. Government final testing will not be performed until after the connections to the installation-wide fire reporting system and the installation-wide mass notification system have been completed and tested to confirm communications are fully functional. Submit request for test at least 15 calendar days prior to the requested test date.

3.6.3 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests must be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.6.4 Government Final Tests

The tests must be performed in accordance with the approved test procedures in the presence of the DFPE. Furnish instruments and personnel required for the tests. The following must be provided at the job site for Government Final Testing:

a. The manufacturer's technical representative.

b. The contractor's Qualified Fire Protection Engineer (QFPE).

c. Marked-up red line drawings of the system as actually installed.

d. Loop resistance test results.

e. Complete program printout including input/output addresses.

f. Copy of pre-Government Test Certificate, test procedures and completed test data forms.

g. Audibility test results with marked-up floor plans.

h. Intelligibility test results with marked-up floor plans.

Government Final Tests will be witnessed by the Contracting Officer's Representative (COR) and the Qualified Fire Protection Engineer (QFPE). At this time, any and all required tests noted in the paragraph "Minimum System Tests" must be repeated at their discretion.

3.7 MINIMUM SYSTEM TESTS

3.7.1 System Tests

Test the system in accordance with the procedures outlined in NFPA 72. The required tests are as follows:

a. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests must be witnessed by the Contracting Officer and test results recorded for use at the final Government test.

b. Verify the absence of unwanted voltages between circuit conductors and ground. The tests must be accomplished at the pre-Government test with results available at the final system test.

c. Verify that the control unit is in the normal condition as detailed in the manufacturer's O&M manual.

d. Test each initiating device and notification appliance and circuit for proper operation and response at the control unit. Smoke detectors must be tested in accordance with manufacturer's recommended calibrated test method. Use of magnets is prohibited. Testing of duct smoke detectors must comply with the requirements of NFPA 72 except disconnect at least 20 percent of devices. If there is a failure at these devices, then supervision must be tested at each device.

e. Test the system for specified functions in accordance with the contract drawings and specifications and the manufacturer's O&M manual.

f. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the time period and in the manner specified.

g. Determine that the system is operable under trouble conditions as specified.

h. Visually inspect wiring.

i. Test the battery charger and batteries.

j. Verify that software control and data files have been entered or programmed into the FMCU. Hard copy records of the software must be provided to the Contracting Officer.

k. Verify that red-line drawings are accurate.

l. Measure the current in circuits to ensure there is the calculated spare capacity for the circuits.

m. Measure voltage readings for circuits to ensure that voltage drop is not excessive.

n. Disconnect the verification feature for smoke detectors during tests to minimize the amount of smoke needed to activate the sensor. Testing of smoke detectors must be conducted using real smoke or the use of canned smoke which is permitted.

o. Measure the voltage drop at the most remote appliance (based on wire length) on each notification appliance circuit.

p. Verify the documentation cabinet is installed and contains all as-built shop drawings, product data sheets, design calculations, site-specific software data package, and all documentation required by paragraph titled "Test Reports".

3.7.2 Audibility Tests

Sound pressure levels from audible notification appliances must be a minimum of 15 dBa over ambient with a maximum of 110 dBa in any occupiable area. The provisions for audible notification (audibility and intelligibility) must be met with doors, fire shutters, movable partitions, and similar devices closed.

3.7.3 Intelligibility Tests

Intelligibility testing of the System must be accomplished in accordance with NFPA 72 for Voice Evacuation Systems, and ASA S3.2. Following are the specific requirements for intelligibility tests:

a. Intelligibility Requirements: Verify intelligibility by measurement after installation.

b. Ensure that a CIS value greater than the required minimum value is provided in each area where building occupants typically could be found. The minimum required value for CIS is .8. Rounding of values is permitted.

c. Areas of the building provided with hard wall and ceiling surfaces (such as metal or concrete) that are found to cause excessive sound reflections may be permitted to have a CIS score less than the minimum required value if approved by the DFPE, and if building occupants in these areas can determine that a voice signal is being broadcast and they must walk no more than 33 feet to find a location with at least the minimum required CIS value within the same area.

d. Areas of the building where occupants are not expected to be normally present are permitted to have a CIS score less than the minimum required value if personnel can determine that a voice signal is being broadcast and they must walk no more than 50 feet to a location with at least the minimum required CIS value within the same area.

e. Take measurements near the head level applicable for most personnel in the space under normal conditions (e.g., standing, sitting, sleeping, as appropriate).

f. The distance the occupant must walk to the location meeting the minimum required CIS value must be measured on the floor or other walking surface as follows:

(1) Along the centerline of the natural path of travel, starting from any point subject to occupancy with less than the minimum required CIS value.

(2) Curving around any corners or obstructions, with a 12 inches clearance there from.

(3) Terminating directly below the location where the minimum required CIS value has been obtained.

Use commercially available test instrumentation to measure intelligibility as specified by NFPA 72 as applicable. Use the mean value of at least three readings to compute the intelligibility score at each test location.

3.8 SYSTEM ACCEPTANCE

Following acceptance of the system, as-built drawings and O&M manuals must be delivered to the Contracting Officer for review and acceptance. The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final Government test of the system. At least one set of as-built (marked-up) drawings must be provided at the time of, or prior to the Final Government Test.

a. The drawings must be prepared electronically and sized no less than the contract drawings. Furnish one set of CDs or DVDs containing software back-up and CAD based drawings in latest version of AutoCAD and portable document formats of as-built drawings and schematics.

b. Include complete wiring diagrams showing connections between devices and equipment, both factory and field wired.

c. Include a riser diagram and drawings showing the as-built location of devices and equipment.

d. Provide Operation and Maintenance (O&M) Instructions.

3.9 INSTRUCTION OF GOVERNMENT EMPLOYEES

3.9.1 Instructor

Provide the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the operation, inspection, testing, and maintenance of the system provided. The instructor must train the Government employees designated by the Contracting Officer, in the care, adjustment, maintenance, and operation of the fire alarm system. The instructor must be thoroughly familiar with all parts of this installation. The instructor must be trained in operating theory as well as in practical O&M work. Submit the instructors information and qualifications including the training history.

3.9.2 Required Instruction Time

Provide 8 hours of instruction after final acceptance of the system. The instruction must be given during regular working hours on such dates and times selected by the Contracting Officer. The instruction may be divided into two or more periods at the discretion of the Contracting Officer. The training must allow for rescheduling for unforeseen maintenance and/or fire department responses.

3.9.2.1 Technical Training

Equipment manufacturer or a factory representative must provide 1 days of on site. Training must allow for classroom instruction as well as individual hands on programming, troubleshooting and diagnostics exercises. Factory training must occur within 6 months of system acceptance.

3.9.3 Technical Training Manual

Provide, in manual format, lesson plans, operating instructions, maintenance procedures, and training data for the training courses. The operations training must familiarize designated government personnel with proper operation of the installed system. The maintenance training course must provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

3.10 EXTRA MATERIALS

3.10.1 Repair Service/Replacement Parts

Repair services and replacement parts for the system must be available for a period of 10 years after the date of final acceptance of this work by the Contracting Officer. During the warranty period, the service technician must be on-site within 24 hours after notification. All repairs must be completed within 24 hours of arrival on-site.

During the warranty period, the installing fire alarm contractor is responsible for conducting all required testing and maintenance in accordance with the requirements and recommended practices of NFPA 72 and the system manufacturers. Installing fire alarm contractor is NOT responsible for any damage resulting from abuse, misuse, or neglect of equipment by the end user.

3.10.2 Spare Parts

Spare parts furnished must be directly interchangeable with the corresponding components of the installed systems. Spare parts must be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts must be delivered to the Contracting Officer at the time of the Government testing and must be accompanied by an inventory list.

3.10.3 Document Storage Cabinet

Upon completion of the project, but prior to project close-out, place in the document storage cabinet copies of the following record documentation:

a. As-built shop drawings

b. Product data sheets

c. Design calculations

d. Site-specific software data package

e. All documentation required by SD-06.

-- End of Section --

SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

d. Material character is indicated by the boring logs.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Publications used shall be the most current issue.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2017) Installation of Ductile-Iron Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M	(2022) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)

ASTM A252	(2010) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C33/C33M	(2023) Standard Specification for Concrete Aggregates
ASTM D1140	(2017) Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2487	(2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4944	(2018) Standard Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester Method
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D7928	(2017) Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis

1.3 DEFINITIONS

1.3.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SP-SM. Satisfactory materials for grading comprise stones less than 8 inches. To be considered satisfactory, any offsite soils imported for use as backfill shall be tested and certified as meeting local, state, and federal regulation for clean fill prior to bringing to the site. Provide at least one borrow site testing from each borrow site used.

1.3.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.3.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D4318, ASTM C136, ASTM D1140 and ASTM D7928.

1.3.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.3.5 Topsoil

Material suitable for topsoils obtained from offsite areas is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.3.6 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 3 inch in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.3.7 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.3.8 Select Granular Material

1.3.8.1 General Requirements

Select granular material consist of materials classified as GW, GP, SW, or SP, by ASTM D2487 where indicated. The liquid limit of such material must not exceed 15 percent when tested in accordance with ASTM D4318. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM D4318, and not more than 30 percent by weight may be finer than No. 200 sieve, and not more than 65 percent by weight finer than a No. 40 sieve when tested in accordance with ASTM C136.

1.3.9 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks 3 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than 1 inch in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.4 SYSTEM DESCRIPTION

Subsurface soil boring logs are included on plan sheet C002. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.4.1 Classification of Excavation

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.4.2 Blasting

Blasting will not be permitted.

1.4.3 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Dewatering Work Plan

SD-03 Product Data

Utilization of Excavated Soils

SD-06 Test Reports

Testing

Borrow Site Testing Within 24 hours of conclusion of physical tests, submit digital copies of test results, including calibration curves and results of calibration tests, and certification that imported material is free of contamination and meets all local, state, and federal regulations for clean fill.

SD-07 Certificates

Testing

Qualifications of the Corps validated commercial testing laboratory or the contractor's validated testing facilities.

PART 2 PRODUCTS

2.1 BURIED WARNING AND IDENTIFICATION TAPE

Provide metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes	
Red	Electric
Yellow	Gas
Orange	Telephone and Other Communications
Blue	Water Systems
Green	Sewer Systems

2.1.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.1.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.2 MATERIAL FOR RIP-RAP

Provide filter fabric and rock conforming to these requirements for construction indicated.

2.2.1 Rock

Provide rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. Provide fragments sized so that no individual fragment exceeds a weight of 150 pounds and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 2 pounds or less each. Provide rock with a minimum specific gravity of 2.50.

2.3 CAPILLARY WATER BARRIER

Provide capillary water barrier of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Conform to ASTM C33/C33M for fine aggregate grading with a maximum of 3 percent by weight passing ASTM D1140, No. 200 sieve.

2.4 PIPE CASING

2.4.1 Casing Pipe

ASTM A139/A139M, Grade B, or ASTM A252, Grade 2, smooth wall pipe. Match casing size to the outside diameter and wall thickness as indicated. Protective coating is not required on casing pipe.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 4 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 1 inch in diameter, and other materials that would interfere with planting and maintenance operations. Remove from the site any surplus of topsoil from excavations and gradings.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.4 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least 2 foot below the working level. Operate dewatering system continuously until construction work below existing water levels is complete.

3.2.5 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than 5 feet high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Shore vertical trench walls more than 4 feet high. Excavate trench walls which are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter, and do not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.2.5.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of 3 inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.2.5.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, remove such material 12 inch below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.5.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.2.5.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members.

Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.5.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.2.6 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Perform work adjacent to utilities as indicated in accordance with procedures outlined by utility provider. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.2.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from approved private sources. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners.Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.4 SHORING

3.4.1 General Requirements

Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

3.5 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect all surfaces from erosion resulting from ponding or water flow.

3.6 GROUND SURFACE PREPARATION

3.6.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.6.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3.7 UTILIZATION OF EXCAVATED SOILS

3.7.1 Soil Reuse

Satisfactory materials may be re-used on the job site. Unsatisfactory materials shall be disposed off-site in a legal manner and replaced with satisfactory borrow materials.

3.8 BURIED TAPE AND DETECTION WIRE

3.8.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.8.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over it's entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.9 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least 95 percent laboratory maximum density for cohesionless materials, to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.9.1 Trench Backfill

Backfill trenches to the grade shown.

3.9.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.

3.9.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inches loose thickness.

3.9.1.3 Bedding and Initial Backfill

Place initial backfill material,(in compacted lifts of 8" or less for mechanical compaction and 4" or less for manual compaction), and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 95 percent of ASTM D1557 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:

3.9.1.3.1 Class I

Angular, 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

3.9.1.3.2 Class II

Coarse sands and gravels with maximum particle size of 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

3.9.1.4 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:

3.9.1.4.1 Roadways

Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.

3.9.1.4.2 Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas

Deposit backfill in layers of a maximum of 12 inches loose thickness, and compact it to 90 percent maximum density for cohesionless soils.

3.9.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 days, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.10 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.10.1 Gas Distribution

Excavate trenches to a depth that will provide a minimum 24 inch of cover in other excavation.

3.10.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.10.3 Electrical Distribution System

Provide a minimum cover of 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.10.4 Pipeline Casing

Provide new smooth wall steel pipeline casing under new existing pavement by the boring and jacking method of installation. Provide each new pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated. Install pipeline casing by dry boring and jacking method as follows:

3.10.4.1 Bore Holes

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.10.4.2 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.10.4.3 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities.

3.10.5 Rip-Rap Construction

Construct rip-rap on filter fabric in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.10.5.1 Bedding Placement

Spread filter fabric on prepared subgrade as indicated.

3.10.5.2 Stone Placement

Place rock for rip-rap on filter fabric to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.11 EMBANKMENTS

3.11.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 8 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.12 SUBGRADE PREPARATION

3.12.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade of the roadway and parking lots with six passes of a 15 ton (min) vibratory roller. Operate the roller in a systematic manner to ensure the number of passes over all areas, and at speeds between 2-1/2 to 3-1/2 mph. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Undercut rutting or pumping of material as directed by the Contracting Officer and replace with fill and backfill material.

3.12.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Bring up low areas resulting from removal of unsatisfactory material to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3.12.3 Compaction

Finish compaction by pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas compact each layer of the embankment to at least 90 percent of laboratory maximum density.

3.12.3.1 Subgrade for Pavements and Building Pads

Compact subgrade for pavements and building pads to at least 98 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 12 inch of subgrade.

3.13 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.13.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.13.2 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.14 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 3 inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from offsite areas.

3.15 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer.

a. Determine field in-place density in accordance with ASTM D1556 ASTM D2167 or ASTM D6938. When ASTM D6938 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D1556. ASTM D6938 results in a wet unit weight of soil in determining the moisture content of the soil when using this method.

b. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements.

c. Perform tests on recompacted areas to determine conformance with specification requirements. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.15.1 Fill and Backfill Material Gradation

One test per 1000 cubic yards stockpiled or in-place source material. Test each visually different material separately. Determine gradation of fill and backfill material in accordance with ASTM C136 or ASTM D1140.

3.15.2 In-Place Densities

a. One test per 2500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 1000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. Refer to Geotechnical Report for testing requirement within the limits of the building.

3.15.3 Check Tests on In-Place Densities

If ASTM D6938 is used, check in-place densities by ASTM D1556 as follows:

a. One check test per lift for each 5000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each 2000 square feet, of fill or backfill areas compacted by hand-operated machines.

3.15.4 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer. Determine soil moisture per ASTM D4944.

3.15.5 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values per ASTM D1557. One representative test per 1000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.15.6 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.15.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 1, foot above the top of the pipe, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer. Inspect pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.16 DISPOSITION OF SURPLUS MATERIAL

Dispose surplus soil materials off government property in a legal manner.

-- End of Section --

SECTION 32 16 19

CONCRETE CURBS, GUTTERS AND SIDEWALKS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Publications used shall be the most current issue.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005; R 2017) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M	(2022) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A615/A615M	(2022) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C171	(2020) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2023) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2022) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	(2019) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2023) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C920	(2018) Standard Specification for

	Elastomeric Joint Sealants
ASTM D1751	(2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D5893/D5893M	(2016) Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM	(2017) Standard And Commentary Accessible and Usable Buildings and Facilities

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

Biodegradable Form Release Agent

SD-06 Test Reports

Field Quality Control

1.3 EQUIPMENT, TOOLS, AND MACHINES

1.3.1 General Requirements

Plant, equipment, machines, and tools used in the work will be subject to approval and must be maintained in a satisfactory working condition at all times. Use equipment capable of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Discontinue using equipment that produces unsatisfactory results. Allow the Contracting Officer access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.3.2 Slip Form Equipment

Slip form paver or curb forming machines, will be approved based on trial use on the job and must be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass.

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period.

1.4.2 Placing During Warm Weather

The temperature of the concrete as placed must not exceed 85 degrees F except where an approved retarder is used. Cool the mixing water and aggregates as necessary to maintain a satisfactory placing temperature. The placing temperature must not exceed 95 degrees F at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE except as otherwise specified. Concrete must have a minimum compressive strength of 3500 psi at 28 days. Size of aggregate must not exceed 1-1/2 inches. Submit copies of certified delivery tickets for all concrete used in the construction.

2.1.1 Air Content

Use concrete mixtures that have an air content by volume of concrete of 3 to 6 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

Use concrete with a slump of 2 inches plus or minus 1 inch for hand placed concrete or 1 inch plus or minus 1/2 inch for slipformed concrete as determined in accordance with ASTM C143/C143M.

2.1.3 Reinforcement Steel

Use reinforcement bars conforming to ASTM A615/A615M. Use wire mesh reinforcement conforming to ASTM A1064/A1064M.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Use impervious sheet materials conforming to ASTM C171, type optional, except that polyethylene film, if used, must be white opaque.

2.2.2 Burlap

Use burlap conforming to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

Use white pigmented membrane-forming curing compound conforming to ASTM C309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Use concrete protection materials consisting of a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Use hard-pressed fiberboard contraction joint filler for curb and gutter.

2.4.2 Expansion Joint Filler, Premolded

Onless otherwise indicated, use 1/2 inch thick premolded expansion joint filler conforming to ASTM D1751 or ASTM D1752.

2.5 JOINT SEALANTS

Use cold-applied joint sealant conforming to ASTM C920 or ASTM D5893/D5893M.

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Use wood or steel forms that are straight and of sufficient strength to resist springing during depositing and consolidating concrete.

2.6.1 Wood Forms

Use forms that are surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Use forms with a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness.

2.6.2 Steel Forms

Use channel-formed sections with a flat top surface and welded braces at each end and at not less than two intermediate points. Use forms with interlocking and self-aligning ends. Provide flexible forms for radius forming, corner forms, form spreaders, and fillers as needed. Use forms with a nominal length of 10 feet and that have a minimum of 3 welded stake pockets per form. Use stake pins consisting of solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.3 Sidewalk Forms

Use sidewalk forms that are of a height equal to the full depth of the finished sidewalk.

2.6.4 Curb and Gutter Forms

Use curb and gutter outside forms that have a height equal to the full depth of the curb or gutter. Use rigid forms for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

2.6.5 Biodegradable Form Release Agent

Where practicable, use form release agent that is colorless and biodegradableand that is composed of at least 87 percent biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.7 Detectable Warning System

Detectable Warning Systems shown on the Contract plans are to meet requirements of ICC A117.1 COMM - Section 705.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

Construct subgrade to the specified grade and cross section prior to concrete placement.

3.1.1 Sidewalk Subgrade

Place and compact the subgrade in accordance with Section 31 00 00 EARTHWORK. Test the subgrade for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

Place and compact the subgrade in accordance with Section 31 00 00 EARTHWORK. Test the subgrade for grade and cross section by means of a template extending the full width of the curb and gutter. Use subgrade materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

Maintain subgrade in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade must be in a moist condition when concrete is placed. Prepare and protect subgrade so that it is free from frost when the concrete is deposited.

3.2 FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Use additional stakes and braces at corners, deep sections, and radius bends, as required. Use clamps, spreaders, and braces where required to ensure rigidity in the forms. Remove forms in a manner that will not injure the concrete. Do not use bars or heavy tools against the concrete when removing the forms. Promptly and satisfactorily repair concrete found to be defective after form removal. Clean forms and coat with form oil or biodegradable form release agent each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Set forms for sidewalks with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment must be checked with a 10 foot straightedge. Sidewalks must have a transverse slope as indicated or of 1/4 inch per foot where not indicated as the plans. Unless otherwise indicated, construct sidewalks that are located adjacent to curbs with the low side adjacent to the curb. Do not remove side forms less than 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

Remove forms used along the front of the curb not less than 2 hours nor more than 6 hours after the concrete has been placed. Do not remove forms used along the back of curb until the face and top of the curb have been finished, as specified for concrete finishing. Do not remove gutter forms while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks must be of the thickness indicated. Use a strike-off guided by side forms after concrete has been placed in the forms to bring the surface to proper section to be compacted. Consolidate concrete by tamping and spading or with an approved vibrator. Finish the surface to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. Produce a scored surface by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

Finish all slab edges, including those at formed joints, with an edger having a radius of 1/8 inch. Edge transverse joints before brooming. Eliminate the flat surface left by the surface face of the edger with brooming. Clean and solidly fill corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing with a properly proportioned mortar mixture and then finish.

3.3.4 Surface and Thickness Tolerances

Finished surfaces must not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Place concrete to the required section in a single lift. Consolidate concrete using approved mechanical vibrators. Curve shaped gutters must be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Float and finish exposed surfaces with a smooth wood float until true to grade and section and uniform in texture. Brush floated surfaces with a fine-hair brush using longitudinal strokes. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the front curb surface, while still wet, in the same manner as the gutter and curb top. Finish the top surface of gutter and entrance to grade with a wood float.

3.4.4 Joint Finishing

Finish curb edges at formed joints as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces must not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Construct sidewalk joints to divide the surface into rectangular areas. Space transverse contraction joints at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and continuous across the slab. Construct longitudinal contraction joints along the centerline of all sidewalks 10 feet or more in width. Construct transverse expansion joints at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, install transverse expansion joints as indicated. Form expansion joints around structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

Form contraction joints in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness. Unless otherwise approved or indicated, either use a jointer to cut the groove or saw a groove in the hardened concrete with a power-driven saw. Construct sawed joints by sawing a groove in the concrete with a 1/8 inch blade. Provide an ample supply of saw blades on the jobsite before concrete placement is started. Provide at least one standby sawing unit in good working order at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Form expansion joints using 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D1752 or building paper. Hold joint filler in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, round joint edges using an edging tool having a radius of 1/8 inch. Remove any concrete over the joint filler. At the end of the curing period, clean the top of expansion joints and fill with cold-applied joint sealant. Use joint sealant that is gray or stone in color. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Apply joint sealing material only when the concrete at the joint is surface dry and atmospheric and concrete temperatures are above 50 degrees F. Immediately remove any excess material on exposed surfaces of the concrete and clean the concrete surfaces.

3.6 CURB AND GUTTER JOINTS

Construct curb and gutter joints at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Construct contraction joints directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

a. Construct contraction joints (except for slip forming) by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Remove separators as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

b. When slip forming is used, cut the contraction joints in the top portion of the gutter/curb hardened concrete in a continuous cut across the curb and gutter, using a power-driven saw. Cut the contraction joint to a depth of at least one-fourth of the gutter/curb depth using a 1/8 inch saw blade.

3.6.2 Expansion Joints

Form expansion joints by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Construct expansion joints in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement using the same type and thickness of joints as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, provide expansion joints at least 1/2 inch in width at intervals not less than 30 feet nor greater than 120 feet. Seal expansion joints immediately following curing of the concrete or as soon thereafter as weather conditions permit. Seal expansion joints and the top 1 inch depth of curb and gutter contraction-joints with joint sealant. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Concrete at the joint must be surface dry and atmospheric and concrete temperatures must be above 50 degrees F at the time of application of joint sealing material. Immediately remove excess material on exposed surfaces of the concrete and clean concrete surfaces.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete must be on hand and ready for use before actual concrete placement begins. Protect concrete as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

Cover the entire exposed surface with two or more layers of burlap. Overlap mats at least 6 inches. Thoroughly wet the mat with water prior to placing on concrete surface and keep the mat continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

Wet the entire exposed surface with a fine spray of water and then cover with impervious sheeting material. Lay sheets directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. Use sheeting that is not less than 18-inches wider than the concrete surface to be cured. Secure sheeting using heavy wood planks or a bank of moist earth placed along edges and laps in the sheets. Satisfactorily repair or replace sheets that are torn or otherwise damaged during curing. Sheeting must remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

Apply a uniform coating of white-pigmented membrane-curing compound to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Coat formed surfaces immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Do not allow concrete surface to dry before application of the membrane. If drying has occurred, moisten the surface of the concrete with a fine spray of water and apply the curing compound as soon as the free water disappears. Apply curing compound in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. Apply the second coat in a direction approximately at right angles to the direction of application of the first coat. The compound must form a uniform, continuous, coherent film that will not check, crack, or peel and must be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, apply an additional coat to the affected areas within 30 minutes. Respray concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied by the method and at the coverage specified above. Respray areas where the curing compound is damaged by subsequent construction operations within the curing period. Take precautions necessary to ensure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. Tightly seal the top of the joint opening and the joint groove at exposed edges before the concrete in the region of the joint is resprayed with curing compound. Use a method used for sealing the joint groove that prevents loss of moisture from the joint during the entire specified curing period. Provide approved standby facilities for curing concrete pavement at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Adequately protect concrete surfaces to which membrane-curing compounds have been applied during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, remove debris and backfill, grade, and compact the area adjoining the concrete to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Protect completed concrete from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Remove and reconstruct concrete that is damaged for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Dispose of removed material as directed.

3.8 FIELD QUALITY CONTROL

Submit copies of all test reports within 24 hours of completion of the test.

3.8.1 General Requirements

Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit reports as required below, and additional tests to ensure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

Take concrete samples in accordance with ASTM C172/C172M not less than once a day nor less than once for every 250 cubic yards of concrete placed. Mold cylinders in accordance with ASTM C31/C31M for strength testing by an approved laboratory. Each strength test result must be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Determine air content in accordance with ASTM C173/C173M or ASTM C231/C231M. Use ASTM C231/C231M with concretes and mortars made with relatively dense natural aggregates. Make two tests for air content on randomly selected batches of each class of concrete placed during each shift. Make additional tests when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. Notify the placing forman if results are out of tolerance. The placing foreman must take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Perform two slump tests on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Perform additional tests when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

Determine the anticipated thickness of the concrete prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, construct the subgrade true to grade prior to concrete placement. The thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

Provide finished surfaces for each category of the completed work that are uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, reduce high areas either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete must not exceed 5 percent of the area of any integral slab, and the depth of grinding must not exceed

1/4 inch. Remove and replace pavement areas requiring grade or surface smoothness corrections in excess of the limits specified.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Contracting Officer and deficiencies in appearance will be identified. Remove and replace areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work.

3.10 DETECTABLE WARNING SYSTEM

Install Detectable Warning Systems required by Contract plans in accordance with ICC A117.1 COMM, Section 705, and by manufacturers' installation instructions.

-- End of Section --

SECTION 32 92 23

SODDING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Publications used shall be the most current issue.

ASTM INTERNATIONAL (ASTM)

ASTM C602	(2023) Agricultural Liming Materials
ASTM D4427	(2018) Standard Classification of Peat Samples by Laboratory Testing
ASTM D4972	(2018) Standard Test Methods for pH of Soils

TURFGRASS PRODUCERS INTERNATIONAL (TPI)

TPI GSS	(1995) Guideline Specifications to Turfgrass Sodding

U.S. DEPARTMENT OF AGRICULTURE (USDA)

DOA SSIR 42	(2022) Kellogg Soil Survey Laboratory Methods Manual, Soil Survey Investigations Report, No. 42, Version 6.0

1.2 DEFINITIONS

1.2.1 Stand of Turf

100 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil composition tests (reports and recommendations).

SD-07 Certificates

Sod farm certification for sods. Indicate type of sod in accordance with TPI GSS.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Sod Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Sod Storage

Lightly sprinkle with water, cover with moist burlap, straw, or other approved covering; and protect from exposure to wind and direct sunlight until planted. Provide covering that will allow air to circulate so that internal heat will not develop. Do not store sod longer than 24 hours. Do not store directly on concrete or bituminous surfaces.

1.5.2.2 Topsoil

Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Sod

Place sod a maximum of thirty six hours after initial harvesting, in accordance with TPI GSS as modified herein.

PART 2 PRODUCTS

2.1 SODS

2.1.1 Classification

Nursery grown, certified as classified in the TPI GSS. Machine cut sod at a uniform thickness of 3/4 inch within a tolerance of 1/4 inch, excluding top growth and thatch. Each individual sod piece shall be strong enough to support its own weight when lifted by the ends. Broken pads, irregularly shaped pieces, and torn or uneven ends will be rejected.Wood pegs and wire staples for anchorage shall be as recommended by sod supplier.

2.1.2 Purity

Sod species shall be genetically pure, free of weeds, pests, and disease.

2.1.3 Planting Dates

Lay sod from February to August for warm season spring planting and from September to November for cool season fall planting.

2.1.4 Composition

2.1.4.1 Proportion

Proportion grass species as indicated on plans.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section 31 00 00 EARTHWORK.

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor, if required.

2.2.3 Composition

Containing from 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH shall be tested in accordance with ASTM D4972. Topsoil shall be free of sticks, stones, roots, and other debris and objectionable materials. Other components shall conform to the following limits:

Silt	7 to 17 percent
Clay	4 to 12 percent
Sand	70 to 82 percent
pH	5.5 to 7.0
Soluble Salts	600 ppm maximum

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3.1 Lime

Commercial grade hydrate or burnt limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C602 of not less than 110 percent.

2.3.2 Iron

100 percent elemental

2.3.3 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D4427. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation.

2.3.4 Sand

Clean and free of materials harmful to plants.

2.3.5 Perlite

Horticultural grade.

2.3.6 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.3.6.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.3.6.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Synthetic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

12 percent available nitrogen
8 percent available phosphorus
8 percent available potassium

2.5 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation containing no element toxic to plant life.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Extent Of Work

Provide soil preparation (including soil conditioners), fertilizing, and sodding of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.2 Soil Preparation

Provide 4 inches of topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer pH adjusters and soil conditioners into soil a minimum depth of 3 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.2.1 Soil Conditioner and Fertilizer Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site.

3.2 SODDING

3.2.1 Finished Grade and Topsoil

Prior to the commencement of the sodding operation, the Contractor shall verify that finished grades are as indicated on drawings; the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 31 00 00 EARTHWORK.

The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove from the surface debris and stones over a minimum 5/8 inch in any dimension.

3.2.2 Placing

Place sod a maximum of 36 hours after initial harvesting, in accordance with TPI GSS as modified herein.

3.2.3 Sodding Slopes and Ditches

For slopes 2:1 and greater, lay sod with long edge perpendicular to the contour. For V-ditches and flat bottomed ditches, lay sod with long edge perpendicular to flow of water. Anchor each piece of sod with wood pegs or wire staples maximum 2 feet on center. On slope areas, start sodding at bottom of the slope.

3.2.4 Finishing

After completing sodding, blend edges of sodded area smoothly into surrounding area. Air pockets shall be eliminated and a true and even surface shall be provided. Frayed edges shall be trimmed and holes and missing corners shall be patched with sod.

3.2.5 Rolling

Immediately after sodding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.

3.2.6 Watering

Start watering areas sodded as required by daily temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to minimum depth of 4 inches. Run-off, puddling, and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over turf areas. Watering of other adjacent areas or plant material shall be prevented.

Water sufficiently to ensure that sod receives at least 2 inches of water per week (including rainfall). Continue watering until sod is well-rooted. Minimum watering time shall be sixty (60) days from placement.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 ESTABLISHMENT PERIOD

Contractor shall monitor and maintain sod until such time that all sod is well-rooted and no bare spots exist exceeding 1 square foot in dimension. All rills and areas of erosion shall be promptly repaired during the maintenance period. Monitoring period shall be a minimum of sixty (60) days following installation. -- End of Section --

SECTION 33 40 00

STORM DRAINAGE UTILITIES
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Publications used shall be the most current issue.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 294	(2021) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2021) Standard Specification for Gray Iron Castings
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM B26/B26M	(2018; E 2018) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C1433	(2020) Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
ASTM C1433M	(2022) Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers (Metric)
ASTM C425	(2021) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C443	(2021) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C443M	(2021) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections

ASTM C478M	(2018) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C76	(2022a) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C76M	(2022a) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C877	(2021) Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C877M	(2021) Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections (Metric)
ASTM C923	(2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C923M	(2008b; R 2013) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
ASTM C990	(2009; R 2019) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D1056	(2020) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1171	(2018) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors (Triangular Specimens)
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for

	Sewers and Other Gravity-Flow Applications
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Pipe for Culverts and Storm Drains

SD-07 Certificates

Resin Certification

Oil Resistant Gasket

Determination of Density

Frame and Cover for Gratings

SD-08 Manufacturer's Instructions

Placing Pipe

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life.

Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe (If required)

Manufactured in accordance with and conforming to ASTM C76, Class III.

2.1.2 Poly Vinyl Chloride (PVC) Pipe

PVC pipe and fittings may be used for roof leader collection system. Submit the pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, prior to installation of the pipe.

2.1.2.1 Type PSM PVC Pipe

ASTM D3034, Type PSM, maximum SDR 35, produced from PVC certified by the Manufacturer as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.3 Polyethylene (PE) Pipe

2.1.3.1 Corrugated PE Pipe (Double Wall)

AASHTO M 294, Type S. For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant ligament-stress (NCLS) test meeting the requirements of AASHTO M 294. Pipe walls shall have minimum OD (inch) 22 inches for 18 inch nominal pipe and 28 inches for 24 inch nominal pipe.

2.2 DRAINAGE STRUCTURES

2.2.1 Precast Reinforced Concrete Box

Manufactured in accordance with and conforming to ASTM C1433.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Reinforced Concrete Manholes

Conform to ASTM C478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.2 Frame and Cover for Gratings

Submit certification on the ability of frame and cover or gratings to carry the imposed live load. Frame and cover for gratings shall be cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.O-T6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.3 Joints

2.3.3.1 Flexible Watertight Joints

a. Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for preformed flexible joint sealants shall conform to ASTM C990, and rubber-type gaskets shall conform to ASTM C443. Factory-fabricated resilient joint materials shall conform to ASTM C425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.3.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C877.

2.3.3.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D1056, Type 2, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of ASTM C990 or ASTM C443. Preformed flexible joint sealants shall conform to ASTM C990, Type B.

2.3.3.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.3.5 Corrugated PE Plastic Pipe

Pipe joints shall be water tight and shall conform to the requirements in AASHTO M 294. Water tight joints shall be made using a PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477.

2.4 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.

2.5 EROSION CONTROL RIP RAP

Provide non-erodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of 8 inches.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK,.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 31 00 00 EARTHWORK.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in granular material minimum 4 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. Bell holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Plastic Pipe

Bedding for PVC and PEpipe shall meet the requirements of ASTM D2321. Use Class IB or II material for bedding, haunching, and initial backfill. Use Class I, II, or III material for PP pipe bedding, haunching and initial backfill.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe, excluding SRPE pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (percent)
Plastic PVC or PE	5

Note post installation requirements of paragraph DEFLECTION TESTING in PART 3 of this specification for all pipe products including deflection testing requirements for flexible pipe.

3.3.1 Concrete, PVC, Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.4 JOINTING

3.4.1 Concrete Pipe

3.4.1.1 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 BACKFILLING

3.6.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint (spring line) of concrete pipe or has reached an elevation of at least 12 inches above the top of the pipe for flexible pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 12 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.6.2 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.6.3 Compaction

3.6.3.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.6.3.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7 FIELD QUALITY CONTROL

3.7.1 Tests

Testing is the responsibility of the Contractor. Perform all testing and retesting at no additional cost to the Government.

3.7.1.1 Determination of Density

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with

ASTM D2167 or ASTM D6938. When ASTM D6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D6938 results in a wet unit weight of soil and ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D6938. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.7.2 Inspection

3.7.2.1 Post-Installation Inspection

Visually inspect each segment of concrete pipe for alignment, settlement, joint separations, soil migration through the joint, cracks, buckling, bulging and deflection.

3.7.2.1.1 Concrete

Cracks with a width greater than 0.01 inches. An engineer must evaluate all pipes with cracks with a width greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required.

3.7.2.1.2 Flexible Pipe

Check each flexible pipe (PE or PVC) for rips, tears, joint separations, soil migration through the joint, cracks, localized bucking, bulges, settlement and alignment.

-- End of Section --

APPENDIX A

FURNITURE, FIXTURES, AND EQUIPMENT (FFE)

AND

STRUCTURAL INTERIOR DESIGN (SID)

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SECTION II – FUNRITURE, FIXTURES, & EQUIPMENT (FF&E) 65% DESIGN SUBMITTAL

DESIGN ANALYSIS

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ADDITION AND RENOVATION B521
EGLIN AIR FORCE BASE, FLORIDA

Chapter 7 – Furniture, Fixtures & Equipment (FF&E)

A. Design Criteria

The following is a list of DoD, Army, and Eglin AFB specific criteria that shall be utilized for the design of this facility. Refer to other chapters for additional criteria specific to each design element.

The following is a list of DoD, and Eglin AFB specific criteria that shall be utilized for the design of this facility. Refer to other chapters for additional criteria specific to each design element.

1. Engineering Design Manual Eglin AFB, Florida, February 2019 with referenced:
   a. Eglin AFB Architectural Compatibility Plan – 2023
   b. 96th Communications Squadron Cyber Infrastructure Design Guide 10 April 2019
   c. CHELCO Design and Construction Standards, December 1, 2008
   d. American States Utility Services, Inc. (ASUS) Standard Details Water and Sewer
2. UFC 1-200-01 General Building Design, September 1, 2022
3. UFC 1-200-02 High Performance Sustainable Building Requirements, 1 Dec. 2020 Change 02, 01 June 2022.
4. UFC 3-120-10 Interior Design, with Change 2, June 15, 2021
5. UFC 3-600-01 Fire Protection Engineering for Facilities, 8 August 2016, Change 6, 6 May 2021
6. UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings, 12 Dec. 2018, Change 2, 30 July 2022
7. UFC 4-021-01 Mass Notification System, 9 April 2008, Change 1, 1 Jan. 2010
8. International Building Code 2021
9. NFPA 101 2021
10. ABA Accessibility Guidelines, (2015)
11. Florida Building Code (2020) & Miami / Dade County Hurricane Standards
12. USGBC LEED Building Design and Construction (BD&C) rating systems, V4.1
13. EPAct2005 - Energy Policy Act Of 2005
14. EISA 2007 - Energy Independence Security Act Of 2007

B. Furniture Fixtures & Equipment Design Statement

This renovation and addition project includes a single-story, 4,500 sq ft. addition and renovation of the existing auditorium space.

AFRL personnel will operate the facility, which will be primarily used for virtual wargaming. The project replaces the auditorium space with space for nine workstations and a large storage mezzanine. Two of the workstations will be larger with collaboration space. The Mezzanine will have a storage area with one workbench and three shelving units to house large pelican cases.

The new addition includes a new 60-person conference room allowing collaboration and interaction with a higher security level, two breakout spaces with an STC-rated operable partition separating them, two new analysis rooms, an AV storage room, and two small storage rooms. A mechanical room is adjacent (outside of the secure perimeter).

C. Individual Room FF&E Requirements

This chapter lists the specific items for each space that will become part of the FF&E requirements for the new addition.

1. **Workstations (formerly the Auditorium)** – Area houses 9 workstations, 6 each 9’ x 8’ and 2 each 9’ x 12’. The two larger workstations are to be collaborative workspaces. Each workstation will have a sliding privacy screen.

2. **Secure Corridor 112A and 120** – No furnishings have been specifically identified for the corridors.

3. **Analysis Rm 1 113, Analysis Rm 4 118, and Analysis Rm 5 119 –** Analysis Rm 1 will have its existing furnishings reworked by removing the end worksurface and the existing classified printers, safe, and shredder. Analysis Rms 4 and 5 shall use 6-position height adjustable workstations like those shown at the meeting and as indicated on the Order Data Sheets. Rooms will also have (2) GFGI – Flat Panel Monitors, (2) Glass Magnetic Marker Boards, and Acoustical Panels to assist with noise mitigation.

4. **Breakout Rooms 125 and 126 -** Breakout Rooms will have (5) 30” x 60” tables on casters with (20) chairs on casters in each room. Rooms will also have (2) GFGI – Flat Panel Monitors, (2) Glass Magnetic Marker Boards, and Acoustical Panels.

5. **Conference Room –** The Conference Room features a Line-of Sight Table. There is space on each side for 30” x 72” tables for alternate seating. The seating from the original auditorium is in excellent condition and will be used at the line-of-sight table and the alternate seating area. Additionally, against the wall will be comfortable upholstered wood side chairs. This space will have an electronic screen and wood/acoustical wall panels. The side walls will have (5) GFGI – Flat Panel Monitors. The front of the room will have credenzas that can serve as AV credenzas or as credenzas that store dishes for serving food. There is an AV desk at the back of the room that can run the meeting.

6. Furnishings are planned to be a Bid Option and will be provided as a turn-key solution.

SPECIFICATIONS

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ADDITION AND RENOVATION B521
EGLIN AIR FORCE BASE, FLORIDA

SECTION 12 50 00.13 10

FURNITURE AND FURNITURE INSTALLATION
08/17, CHG 1: 11/18

PART 1 GENERAL

Purchase and install furniture as identified within this specification. This specification section includes a Furniture, Fixtures and Equipment (FF&E) Package attachment.[

The requirements of this specification also apply to systems furniture unless otherwise specified in Section 12 59 00 Systems Furniture.]

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

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

ASHRAE 90.1 - IP	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM D4157	(2013; R 2017) Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E1537	(2016) Standard Test Method for Fire Testing of Upholstered Furniture

BIFMA INTERNATIONAL (BIFMA)

ANSI/BIFMA X5.1	(2017) American National Standards For Office Furnishings - General Purpose Office Chairs
ANSI/BIFMA X5.5	(2014) American National Standards For Office Furnishings -Desk Products
ANSI/BIFMA X5.6	(2016) American National Standards For Office Furnishings -Panel Systems
ANSI/BIFMA X5.9	(2012) American National Standards For Office Furnishings - Storage Units

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2021; TIA 21-1) Life Safety Code

NFPA 260	(2013) Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture
NFPA 265	(2023; ERTA 1 2023) Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile or Expanded Vinyl Wall Coverings on Full Height Panels and Walls

STATE OF CALIFORNIA DEPARTMENT OF CONSUMER AFFAIRS, BUREAU OF ELECTRICAL AND APPLIANCE REPAIR, HOME FURNISHINGS AND THERMAL INSULATION (BEARHFTI)

TB 117-2013	(2013) Requirements, Test Procedure and Apparatus for Testing the Smolder Resistance of Materials Used in Upholstered Furniture
TB 133	(1991) Flammability Test Procedure for Seating Furniture in Public Occupancies

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

UNDERWRITERS LABORATORIES (UL)

UL 723	(2020) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.~~[for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.]~~ Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Storage Location; G, RO

SD-02 Shop Drawings

Installation Drawings; G, RO

~~[~~Grommet~~[, Power and Communication Units][~~, and Wire Management~~]~~ Locations; G, RO~~]~~

SD-03 Product Data

Product Data; G, RO

Product Style Options; G, RO

SD-04 Samples

Fabric and Finishes; G, RO

SD-07 Certificates

Authorized Dealer; G, RO

Certified Furniture Installers; G, RO

~~Licensed Electrician; G, RO~~

~~Certified Telecommunications Installer; G, RO~~

Manufacturer's Certification; G, RO

Warranty; G, RO

SD-10 Operation and Maintenance Data

Furniture, Data Package 1; G, RO

SD-11 Closeout Submittals

Energy Efficient Equipment; S

Reduced VOC's for Furniture; S

Recycled Content of Furniture; S

Bio-Based Content of Furniture; S

1.3 SERVICES

Provide services to include furniture purchase, field measuring, installation drawings, shipping and delivery coordination, receiving, inspection, submitting and processing freight and warranty claims, unpacking, storing, assembly, installation and other related activities or tasks for a complete and functional installation. Reference Section 01 45 00 QUALITY CONTROL for inspection requirements. The Contracting Officer must be allowed to participate in inspections.~~[~~ In addition provide services for existing furniture as specified, reference paragraph on EXISTING FURNITURE for more information.~~]~~ Develop project timelines and establish shipping, receiving and installation dates that coordinate with the building construction schedule. Hold at a minimum weekly team meetings to brief the project team, include the Contracting Officer. Notify the Contracting Officer immediately of any scheduling problems, discontinued furniture items including fabrics and finishes, or other conditions which may cause delays, and recommend available substitutes, solutions, and provide updated timeline to coordinate with building construction schedule. Substitutes and solutions must comply with the specification and be approved by the Contracting Officer.

1.4 FURNITURE PURCHASE

Purchase furniture, including checking accuracy of all acknowledgements and schedules from manufacturers and making necessary corrections to insure that the manufacturer has a correct understanding of the order and requirement.~~[Provide furniture from the GSA Schedules and provide GSA pricing. Provide furniture from open market only when an item is not available on the GSA Schedules.~~ See FAR clause 52.251-1 Government Supply Sources.~~][~~ Purchase furniture from the open market. The furniture provided needs to be available on the GSA Schedules to assist the User with future purchases. GSA information is provided FOR INFORMATIONAL PURPOSES ONLY. It is encouraged to solicit and provide GSA pricing on furniture.~~]~~ Compete the furniture purchase by obtaining a minimum of (3) separate proposals. Furniture is subject to FAR clause 52.236-5 Materials and Workmanship.~~[~~ If necessary to meet project timeline requirements, furniture may be purchased using manufacturers quick-ship programs or by coordinating factory times.~~]~~

1.5 ALTERNATE DESIGN

When a manufacturer's product is unable to provide desk and workstation configurations and filing/storage that conform exactly to the furniture layouts shown in the contract drawings and specifications, alternate designs may be submitted for consideration by the Contracting Officer. Alternate designs must meet or exceed the following criteria. Alternate designs that are submitted but do not meet these criteria will be rejected.

1.5.1 Desk and Workstation Size and Configuration

The alternate design must provide desks and workstations of the same basic size and configuration shown, with only the sizes of the individual components within the desk and workstation changed to meet the standard product of the manufacturer.

1.5.2 Filing and Storage Size and Configuration

The alternate design must provide filing and storage of the same basic size and configuration shown, with only the size changed to meet the standard product of the manufacturer. The storage capacity must not be reduced.

1.5.3 Furniture Requirements

The furniture provided must comply with the drawings, specifications, and the requirements identified in the FF&E Package Attachment.

1.5.4 Layout

The storage capacity, number of desks and workstations, number of persons accommodated, width of aisles, and functionality must be maintained. Layout must comply with NFPA 101 and 36 CFR 1191.

1.6 AUTHORIZED DEALER, CERTIFIED FURNITURE INSTALLERS, LICENSED ELECTRICIAN AND CERTIFIED TELECOMMUNICATIONS INSTALLER

When required by the furniture manufacturer, furniture must be installed by an authorized dealer and a certified furniture installation crew must be used on the project.~~[~~ Services provided to reuse existing furniture must comply with manufactures warranty requirements to maintain warranty.

If warranty for existing furniture to be reused has expired, services must be completed by a furniture installation crew with a minimum of 5 years experience.~~]~~ ~~All furniture requiring hardwiring must be completed by a licensed electrician. Communications installers must be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level or have a minimum of [3][_____] years experience in the installation of the specified cables and components. All installers, furniture, electrical and communications, must be on-site if questions arise.~~ Submit copies of authorized dealer, furniture installation crew, licensed electrician and certified telecommunications installer certifications.

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Delivery

Deliver furniture to the jobsite in manufacturer's original packaging or blanket wrapping. Original packaging must be marked with the manufacturer name, item identification, and project reference clearly marked.

1.7.2 Furniture Inspection

Inspect furniture and provide notification of damage within the time frame required by the shipping company while carrier is still on-site. Complete claims for concealed damage within the time frame required by the shipping company and furniture manufacturer. A claim file must be maintained that documents each claim. Forward copies of claims to the Contracting Officer on a ~~[~~daily~~][_____]~~ basis.

1.7.3 Storage

Storage space is not available on-site and furniture must be stored at an off site location. Provide any storage space required for furniture and transport stored furniture to the project site for installation. Storage location must be approved by the Contracting Officer at the time of the furniture order. If storage is required, furniture must be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, in a manner that permits easy access for inspection and handling, and in an environment in accordance with furniture manufacturers instructions. Furniture cannot be stored in a shipping container.

1.7.4 Furniture Staging Area

Coordinate location of the furniture staging area with the Contracting Officer.

1.8 WARRANTY

Provide manufacturer performance guarantees or warranties for single-shift service and include parts, labor and transportation as follows, unless otherwise noted:

a. Systems Furniture - ~~[~~see Section12 59 00 Systems Furniture~~][~~12 year minimum~~][lifetime]~~

b. Desks and Workstations - 12 year minimum

c. Filing and Storage - 12 year minimum

d. Seating

(1) Seating, unless otherwise noted - 10 year minimum

(2) 24/7 Seating (multiple shift use) - 10 year minimum

(3) Seating Mechanisms and Pneumatic Cylinders - 10 year minimum

(4) Lounge Seating - 10 year minimum

(5) Stacking Chairs - 10 year minimum

e. Tables

(1) Unless otherwise noted - 10 year minimum

(2) Table Mechanisms - 5 year minimum

(3) Table Ganging Device - 1 year minimum

f. Miscellaneous

(1) Fabric - 3 year minimum

(2) LED Task Lighting - 5 year minimum

(3) Task Lighting - ~~[2][3][_____]~~ year minimum

Provide items not listed with a 1 year minimum. When manufacturers standard performance guarantees or warranties exceed the minimum requirements identified, provide the standard performance guarantee or warranty. Submit manufacturer's warranty information for all furniture items.

PART 2 PRODUCTS

2.1 PRODUCT SUSTAINABILITY CRITERIA

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following:

2.1.1 Energy Efficient Equipment

Coordinate requirement for energy efficient equipment, such as appliances and lighting, and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph ENERGY EFFICIENT EQUIPMENT.

2.1.2 Reduced VOC's for Furniture

Coordinate requirement for reduced VOC requirements for furniture and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS.

2.1.3 Recycled Content of Furniture

Coordinate requirement for recycled content for furniture and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY

REQUIREMENTS AND REPORTING paragraph RECYCLED CONTENT.

2.1.4 Bio-Based Content of Furniture

Coordinate requirement for biobased content for furniture and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph BIO-BASED PRODUCTS.

2.2 REFERENCE TO MANUFACTURER NAMES AND COLORS

Where product and color is shown as being specific to one manufacturer in the FF&E Package Attachment, an equivalent color or product by another manufacturer may be submitted for approval. Manufacturers, style lines, model numbers, finish, and fabric information are provided to establish design intent and are not intended to limit the selection of equal products and colors from other manufacturers.

2.3 FURNITURE REQUIREMENTS

Use the FF&E Package Attachment in conjunction with the drawings and specifications for the furniture requirements.~~[~~ Systems furniture is specified in Section 12 59 00 SYSTEMS FURNITURE.~~]~~ Provide furniture from manufacturer's standard product as shown in the most current published price list or amendment. Furniture provided must be part of current line as indicated with no intent to discontinue within two years. Provide furniture that is intended for commercial use not residential. submit product data for all furniture items, to include catalog cuts, brochures, product information, and other necessary literature to indicate compliance with specifications.~~[~~ Provide product data for all items together in a single submittal.~~][Provide product data for all similar types of items together as a group, such as [desks/workstations,] [seating,] [storage,] [tables,] and [_____]. Submit each grouping of similar type items in a single submittal.] When applicable, include GSA schedule information to confirm that items are available on GSA schedule.~~ Tag product data sheets with applicable furniture item code and name. Submit data for all product style options for selection when options are available. This applies to but is not limited to furniture items that have options such as edge details, hardware options, and grommet colors. Submit manufacturer's certification stating that furniture meets the specifications.~~[~~

2.3.1 EXISTING FURNITURE (GOVERNMENT FURNISHED/CONTRACTOR INSTALLED-GF/CI)

2.3.1.1 Existing Furniture to be Reused

Disassemble, pack, move, store, transport to the project site and install existing furniture identified to be reused. This includes disconnecting and reconnecting furniture electrical connections at the building source. Coordinate with electrician for safe terminations or removal of disconnected building electric system supply circuits.

~~[~~2.3.1.2 Existing Furniture that is Not Reused

[Disassemble and have ready for excessing and pick up any furniture identified as not to be reused. Furniture will be picked up by Government directed vendors. Coordinate pick-up times with Contracting Officer and User.][Disassemble and relocate any furniture identified as not to be reused to the [Defense Logistics Agency Disposition Services (DLADS)][_____] facility.] This includes disconnecting furniture electrical connections at the building source. Coordinate with electrician for safe terminations or removal of disconnected building electric system supply circuits. Protect all items from damage and provide security and weather protection prior to and during[pickup][relocation].

~~][~~2.3.1.3 Existing Furniture Communications

Remove existing Information Technology (IT) cables (i.e. SIPRNET, NIPRNET, J-WIC'S, etc.) and telephone wiring from existing furniture systems identified to be reused or requiring excessing.

~~]]~~2.3.2 Construction

a. Provide furniture that complies with the following testing requirements:

(1) ANSI/BIFMA

~~[~~ (a) Office Seating - ANSI/BIFMA X5.1

~~][~~ ~~(b) Vertical Files - ANSI/BIFMA X5.3~~

~~][~~ ~~(c) Lounge Seating - ANSI/BIFMA X5.4~~

~~][~~ (d) Desk Products - ANSI/BIFMA X5.5

~~][~~ (e) Panel Systems - ANSI/BIFMA X5.6

~~][~~ (f) Storage - ANSI/BIFMA X5.9~~]~~

(2) Flammability

~~[~~ (a) Systems furniture and workstation panel components must meet requirements for flame spread and smoke development as specified by NFPA 101 except as follows. Conduct testing in accordance with either ASTM E84 or UL 723 on the entire assembled panel of the worst case (most combustible) combination of fabric and interior construction. In addition, fabric must meet the requirements of NFPA 265. Do not exceed panel flame spread ~~[~~25 for Class A~~]~~ ~~[75 for Class B] [200 for Class C]~~, and do not exceed panel smoke development 450 for Class A~~, B, and C~~.~~][~~

(b) Upholstered furniture must comply with[TB 117-2013 or NFPA 260][TB 133 or ASTM E1537].~~][~~

~~(c) Mattresses must comply with 16 CFR 1632[and ASTM E1590].]~~

b. Provide furniture with no rough or sharp edges or exposed connections. Clips, screws, and other construction elements must be concealed wherever possible.

c. Items such as desks, workstations and systems furniture must include all necessary components to be structurally sound and must not be attached to the wall unless specified to be wall mounted in the contract documents.

d. Desks, workstations, storage, and tables must have leveling devices to compensate for uneven floors.

e. The underside of desks, workstations, and tables must be completely and smoothly finished.

f. The backside of freestanding desks, workstations, ~~[_____]~~benching stations, tables, and storage must be finished.

g. Provide chair casters and glides appropriate for the floor material they are located on, such as carpet and resilient flooring.

2.3.3 Locks and Keying

a. All drawers and doors, including but not limited to overhead storage cabinets, storage towers, supply cabinets, storage cabinets, desk and workstation pedestals, and filing cabinets must be lockable.

b. Key each desk and workstation in an office differently and key locks within each desk and workstation alike.

c. Furniture storage components in private offices must be keyed alike. Key each private office differently.

d. Provide field changeable lock cylinders in desks and workstations with a minimum of 100 different key options. Number keys and lock cylinders for ease of replacement or clearly label locks with a key number, except for those manufacturers who have removable format locks.

e. Drawers within a pedestal must be lockable either by a central lock that controls all pedestals under one work surface or an individual keyed lock in each pedestal.

f. Central file and storage units which are grouped together but are not a part of a workstation must be keyed ~~[~~alike~~][differently]~~ unless otherwise specified.

g. Provide two keys for each workstation when components are keyed alike. Also provide two keys for each miscellaneous item such as filing cabinets, supply cabinets, storage cabinets, and similar type furniture items.

h. Provide three copies of each master key to the Contracting Officer.~~[~~

i.~~[~~Leave keys in locks~~]~~ ~~[Inventory keys, label keys by lock number, room number and furniture item and turn over inventory and keys to the Contracting Officer]~~.~~]~~

~~2.3.4 Receptacle Bodies and Device Cover Plates~~

~~Provide furniture panel faceplates and receptacle body types [and color] as specified in [FF&E Package Attachment] [12 59 00 SYSTEMS FURNITURE] [_____]. [Provide color as follows:~~

~~a. Faceplate: [match panel trim color][_____]~~

~~b. Receptacle Bodies: [match panel trim color][_____]~~

~~c. Communication Cable Jackets: [match receptacle device cover plates in color][_____]~~

~~d. Isolated Ground Receptacles:[orange][or][have distinct~~

~~markings][be of a different color than other receptacles]]~~

2.3.4 Keyboard Tray

Provide worksurfaces that are capable of accepting an articulating keyboard tray at locations indicated. The keyboard tray must be capable of fully recessing under the work surface and extending to give the user full access to the keyboard. The keyboard tray must have height adjustability and positive and negative tilting capability and have 180-degree swing side travel rotation. The keyboard tray must have a wrist support and include a mouse pad at the same level as the keyboard that can accommodate both right and left handed users.

2.3.5 Fabric and Finish

Submit samples of all furniture fabric and finishes. Samples must be actual samples, not photographic representations, size must be a minimum of 3 by 3 inches. If necessary, provide larger size samples to clearly represent pattern. Label samples with fabric or finish code, furniture item code and name, manufacturer name, and color information. Fabric samples must also be labeled with fiber content and double rub testing information.

2.3.5.1 Fabric

a. Fabric must be from manufacturer's standard line~~[~~ and~~][~~,~~]~~ graded-in textile manufacturer's fabrics~~[~~, and customer's own material (COM)~~]~~.~~[Do not provide COM fabrics.]~~

b. Provide a mid grade fabric~~[~~, unless otherwise noted~~]~~. Example: manufacturer available grades 1 through 4 (even number of grades), provide grade 3; manufacturer available grades A through D (even number of grades), provide grade C; manufacturer available grades A through E (odd number of grades), provide grade C (middle grade).

c. Provide a topical or inherent soil retardant treatment where indicated.

d. ~~[~~Comply with double rub testing as specified in the FF&E Package Attachment.~~][Fabric for seating must comply with a minimum of [55,000][_____] double rubs unless otherwise noted.]~~ Perform double rub testing in accordance with the ASTM D4157 Wyzenbeek Method.

~~e. Provide vinyl, polypropylene or similar type fabric for seating only if allowed in FF&E Package Attachment.~~

f. Pattern:

~~(1) Provide patterned upholstery fabric to help hide soiling. Pattern is defined as follows:~~

~~(a) Solid Color: [textured,] [single color] [or] [pattern smaller in size than the small size pattern][_____]~~

~~(b) Small Size Pattern: minimum [1/2 inch] [_____]~~

~~(c) Medium Size Pattern: minimum [2 inch] [_____]~~

~~(d) Large Size Pattern: minimum [5 inch] [_____]~~

(2) Provide patterns ~~[~~as specified in the FF&E Package Attachment.~~]~~ ~~[~~ as follows:

~~(a) Desk Chairs: [solid color] [small] [_____] size pattern~~

~~(b) Side or Guest Chairs: [small] [medium] [_____] size pattern~~

~~(c) Lounge Type Chairs: [small] [medium] [large] [_____] size pattern~~

~~(d) [_____]: [small] [medium] [large] [_____] size pattern]~~

g. See FF&E Package Attachment for additional information.

2.3.5.2 Finishes

Provide furniture finishes as listed below unless otherwise noted:

a. Finishes must be able to be cleaned with ordinary household cleaning solutions. Wood finishes must be able to be cleaned with damp cloth as directed by the manufacturer.

b. The finish of steel surfaces must be the manufacturer's most durable finish such as factory powder coat or baked enamel.

c. Grommet colors must be compatible and coordinated with desk, workstation, and table finish colors.

~~[~~ d. Finishes must be neutral in color.

~~][~~e. Plastic laminate worksurfaces and table tops must be neutral in color and must have a pattern to help hide soiling.

~~]~~ f. See FF&E Package Attachment for additional information.

2.4 FURNITURE LAYOUT

Provide furniture layout as indicated.

PART 3 EXECUTION

3.1 BUILDING EXAMINATION

Become familiar with details of the work, inspect all areas and conditions under which furniture is to be installed, and coordinate scheduling of dedicated elevators and docks. Notify the Contracting Officer in writing of any conditions detrimental to the proper and timely completion of the installation. Work will proceed only when conditions have been corrected.

3.2 BUILDING PROTECTION

Protect building surfaces to prevent soiling and damage during delivery and installation. Any soiling and damage that occurs to the building during the installation of furniture must be cleaned and repaired, or replaced to its original condition and must be approved by the Contracting Officer.

3.3 INSTALLATION

3.3.1 Installation Drawings

Installation drawings must include furniture layout, critical dimensions and locations of electrical and communications. Reflect field verified conditions in furniture layouts. Drawings must be at 1/4 inch = 1 foot scale, unless otherwise specified. Provide typical plans and isometrics/elevations of desks and workstations at a scale of 1/2 inch = 1 foot. When applicable, provide desk and workstation electrical and communications locations. When applicable include controlled-circuit identification for each furniture receptacle and coordinate with the building electrical system circuits in accordance with ASHRAE 90.1 - IP. Critical dimensions include, but are not limited to clearances and aisle widths. Drawings must include layout for furniture systems workstations for coordination purposes. Label furniture with furniture item code identified in this specification. Submit grommet[, power and communication units][, and wire management] locations.

3.3.2 Furniture Installation Procedures

Complete installation in accordance with manufacturer's installation instructions, assembly manuals, warranty requirements and approved installation drawings. Also comply with the following requirements:

a. Use material handling equipment with rubber wheels.

b. Furniture and components must be installed level, plumb, square, and with proper alignment with adjoining furniture.

c. Match keys to locks and check locking mechanisms.

d. Check drawers, doors, lighting, and other operable items and mechanisms for proper operation.

e. Remove all protective wrapping tape, residue, and related type items.

f. Securely interconnect furniture components where required.

g. Securely attach and anchor furniture components to the building when required.

h. Securely anchor furniture such as shelving and storage units to the building when required by the manufacturer.

i. All items with an electrical plug, such as but not limited to task lighting and tables with electrical power, must be fully operational.

j. All hardwired furniture, such as but not limited to furniture systems, must be fully operational. Verify that voltage is present in electrical outlets. Verify controlled-circuit outlets are properly configured in accordance with the installation drawings.

k. Furniture must not block SIPRNET and comm, or electrical receptacles, ~~[and][_____]~~ jacks or the jack enclosures on walls. Report conflicts to Contracting Officer to discuss resolution.

l. Upon completion of installation, all furniture must be completely cleaned, finished, leveled, aligned, operational and functional.[

m. Install artwork with security mount hardware as recommended by the manufacturer.]

3.3.3 Furniture Communications Installation

~~[Provide all Information/Technology (IT) cables (i.e. SIPRNET, NIPRNET, J-WIC'S, etc.) and phone wiring up to and including the face plate/box of all furniture as required and the services to install the cables, wiring and face plates/boxes in the furniture. Coordinate cable type, cable jacket and outlet jack color with Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. Furniture communication installers must be on site to install communication cables, wiring and other components for furniture during furniture installation. Coordinate the TIA-568.2 pin/pair assignments for communication outlets to match the configuration of the building's non-furniture outlets; coordinate with Contracting Officer. All items with a communication interface must be fully operational.][~~Installation of Information/Technology (IT) wiring, cables and face plates/boxes in the furniture will be completed by others.~~]~~

3.4 CLEANING

Remove all packing materials and other trash from the jobsite. Upon completion of installation, all products must be clean, including inside all drawers and doors, and the area must be free of debris and left in a clean and neat condition. Any defects in or damage to furniture must be repaired or replaced and approved by the Contracting Officer. Damaged products that cannot be satisfactorily repaired must be replaced. Correct any problems with assembly and installation. Prior to any furniture repair, replacement, and/or assembly and installation corrections, protect the building surfaces.

3.5 OPERATION AND MAINTENANCE MANUALS

Submit the Furniture, Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and include the following:

3.5.1 Assembly Manuals

Describe assembly and re-configuration procedures. Provide three sets of installation video tapes if available.

3.5.2 Installation Instructions

Provide a copy of the instructions used to install the furniture. Also describe any special procedures or helpful hints learned during the installation process.

3.5.3 Maintenance Manuals

Describe proper cleaning and minor repair procedures, include cleaning instructions for fabrics.

3.5.4 Electrical System Manuals

Describe the functions, configuration, and maintenance of the furniture electrical system (power~~[~~, communication~~][~~, and data~~]~~). This information may be included in the assembly or maintenance manuals.

3.5.5 Special Tools

Provide ~~[~~three~~][_____]~~ sets of special tools necessary for assembly and disassembly of furniture and components from each manufacturer. Mark tool(s) with manufacturer and product information.

3.5.6 Furniture Drawings

Provide hard copy and electronic, showing installed furniture layout. Include all modifications. Provide electronic copies on a CD-ROM. Coordinate type (such as but not limited to Microstation, AutoCad and Revit) and version required with User. Include critical dimensions, and locations of building and furniture electrical and communications. Provide drawings at 1/4 inch = 1 foot scale, unless otherwise specified. Provide typical plans and isometrics/elevations of workstations at a scale of 1/2 inch = 1 foot. Code all furniture with furniture item code identified in this specification.

3.5.7 Furniture Listing

Provide complete listing, hard copy and electronic, of furniture provided. Include all modifications. Provide electronic copies on a CD-ROM. Coordinate type of electronic file required with User (such as but not limited to Word and Excel). Listing must include furniture item code and name used in FF&E Package, part/model numbers, fabrics and finishes for all components furnished. Organize listing by item name and code and provide building totals.

3.5.8 Order Form Documentation

Provide Order Form Documentation with Purchase Order number and project name and location to allow the User to follow up on warranty issues and help with future purchases.

~~[~~3.5.9 Key Control System

Key Control System. Provide system in excel format; indicate lock number, room number and location of lock within rooms if more than one lock number.
~~]~~

-- End of Section --

SECTION 12 59 00

SYSTEMS FURNITURE
08/17, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN FOREST FOUNDATION (AFF)

ATFS STANDARDS	(2015) American Tree Farm System Standards of Sustainability 2015-2020

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2015) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

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

ASHRAE 90.1 - IP	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 90.1 - SI	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM C423	(2023) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C1048	(2018) Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E290	(2022) Bend Testing of Material for Ductility

BIFMA INTERNATIONAL (BIFMA)

ANSI/BIFMA M7.1	(2011; R 2016) Test Method for Determining VOC Emissions from Office Furniture Systems, Components and Seating
ANSI/BIFMA X5.5	(2014) American National Standards For Office Furnishings -Desk Products

ANSI/BIFMA X5.6	(2016) American National Standards For Office Furnishings -Panel Systems

CSA GROUP (CSA)

CSA Z809-08	(R2013) Sustainable Forest Management

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	(2015) Principles and Criteria for Forest Stewardship

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code
NFPA 101	(2021; TIA 21-1) Life Safety Code
NFPA 265	(2023; ERTA 1 2023) Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile or Expanded Vinyl Wall Coverings on Full Height Panels and Walls

PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION (PEFC)

PEFC ST 2002:2013	(2015) PEFC International Standard Chain of Custody of Forest Based Products Requirements

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

SUSTAINABLE FOREST INITIATIVE (SFI)

SFI 2015-2019	(2015) Standards, Rules for Label Use, Procedures and Guidance

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568.2	(2018d) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-569	(2019e; Add 1 2022) Telecommunications Pathways and Spaces

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

UNDERWRITERS LABORATORIES (UL)

UL 723	(2020) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 1286	(2022; Reprint Aug 2023) UL Standard for Safety Office Furnishings
UL 2818	(2022) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G[, [_____]]

SD-03 Product Data

Warranty; G[, [_____]]

Workstations

Power and Communications

Communications

Recycled Content for system furniture components; S

Energy Star Label for Task Lighting; S

SD-04 Samples

Workstations; G[, [_____]]

Mock-up; G[, [_____]]

Samples

SD-06 Test Reports

Selected Components; G[, [_____]]

Panel Acoustics; G[, [_____]]

Fire Safety; G[, [_____]]

Electrical System; G[, [_____]]

SD-07 Certificates

Workstations

[Certified Sustainably Harvested door panels; S

] SD-10 Operation and Maintenance Data

Assembly Manuals; G[, [_____]]

Maintenance Manuals; G[, [_____]]

Cleaning; G[, [_____]]

Electrical System; G[, [_____]]

Maintenance Agreements

Installation; G

1.3 CERTIFICATIONS

[1.3.1 Certified Sustainably Harvested Wood

Provide wood door panels certified as sustainably harvested by FSC STD 01 001[, ATFS STANDARDS, CSA Z809-08, SFI 2015-2019, or other third party program certified by PEFC ST 2002:2013]. Provide a letter of Certification of Sustainably Harvested Wood signed by the wood supplier. Identify certifying organization and their third party program name and indicate compliance with chain-of-custody program requirements. Submit sustainable wood certification data; identify each certified product on a line item basis. Provide current product certification documentation from certification body. Submit copies of invoices bearing certification numbers.

]1.3.2 Indoor Air QualityCertifications

1.3.2.1 Office Furniture Systems and Seating

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold, ANSI/BIFMA M7.1 Certification or provide certification by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 QUALITY ASSURANCE

1.4.1 General Safety

Provide workstation products free of rough or sharp edges. [Provide panel supported components with a positive, integral locking device which secures components without the use of additional screws or clamps to prevent the components from being accidentally pulled or knocked off the panels.] [Provide desk-based workstation components with an option for a positive, integral locking device that secures components to the base units.]

1.4.2 Fire Safety

Components must meet requirements for flame spread and smoke development as specified by NFPA 101 except as follows. Conduct testing in accordance with either ASTM E84 or UL 723 on the entire assembled panel of the worst case (most combustible) combination of fabric and interior construction. In addition, fabric must meet the requirements of NFPA 265. Do not exceed [[25 for Class A] [75 for Class B] [200 for Class C]] for panel flame spread and 450 for Class A, B and C panel smoke development .

1.4.3 Electrical System

Task lights are required to be UL listed and installation of task lighting must meet the requirements of NFPA 70. The electrical system must meet the requirements of UL 1286. Submit three sets of electrical system manuals describing the functions, configuration, and maintenance of the electrical system (power [, communications] [, data]). This material may be included in the Assembly or Maintenance manuals at the Contractor's option.

1.4.4 Detail Drawings

Submit detail drawings showing communications, electronic data processing (EDP) and local area network (LAN); locations may be provided as a separate submittal from remaining workstation drawings. Provide drawing requirements, which are the furniture manufacturer's responsibility, as a single submittal. Provide electronic drawings to the user for future re-configuration in the software package requested by the user. Include in the electronic drawings all modifications made during installation. As a minimum, submit the following:

a. Overall reference drawings: Drawings showing workstation locations and overall plan view within each floor in a scale of [1/16 inch = 1 foot] [1/8 inch = 1 foot]. Layouts must reflect field verified conditions and clearly illustrate the overall space planning concept and intent.

b. Installation drawings: Drawings showing workstations, panels, components, and plan view within each floor. Identify workstations by workstation type; submit drawings showing the proposed workstation installation at a scale of 1/4 inch = 1 foot, unless otherwise specified. Installation drawings must reflect field verified conditions.

c. Workstation elevations: Dimensioned workstation elevations showing each type of workstation with panel frame configurations and all components identified with manufacturer's catalog numbers. Draw elevations at 1/2 inch = 1 foot scale.

d. Panel drawings: Panel drawings showing locations and critical dimensions from finished face of walls, columns, panels, including clearances and aisle widths. Key assemblies to a legend which includes width, height, configuration and composition of frame covers finishes and fabrics (if different selections exist within a project), power or nonpower, connectors and wall mount hardware. Coordinate panel placement with location of electrical, voice/date LAN,~~[~~ SIPRNet, ~~][~~ NIPERNet,~~]~~ mechanical and fire protection fixtures. Drawings must reflect field verified conditions.

e. Electrical drawings: Drawings showing power provisions including type and location of feeder components (service entry poles, base or ceiling feeds), activated power receptacles and other electrical components. Wiring configuration (circuiting, switching, internal and external connections) identified and a legend provided as applicable. Identify which receptacles in typical furniture configurations will be connected to controlled building power circuits as applicable to meet [ASHRAE 90.1 - IP][ASHRAE 90.1 - SI] requirements. Coordinate with electrical drawings.

f. Wire management capacity drawings.

g. Communication drawings showing telephone provisions: Drawings indicating the type and location of feeder components and communications jacks with wiring configuration identified where applicable.

h. Communication drawings showing electronic data processing provisions: Drawings indicating the type and location of feeder components, communications jacks, or accessories with wiring configuration identified where applicable.

i. Communication drawings showing local area network provisions: Drawings indicating the type and location of feeder components and data jacks with extra ports for future expansion with wiring configuration identified where applicable.

j. Communications drawings indicating the TIA-568.2 pin/pair assignment that will be used for communications outlet as coordinated with the COR.

k. Reflected ceiling plan for projects specified with power poles.

l. Drawings indicating cabling is protected at all transition points, and that metallic separation is provided between telecommunication and power wiring in the utility columns and systems furniture track in accordance with TIA-569 and NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Remove furniture from packaging and store in an unoccupied, dry location that is ventilated. Provide storsge that is free from dirt and dust, water, and other contaminants, and that permits easy access for inspection and handling.

1.6 WARRANTY

Warrant the systems furniture for a minimum period of [12 years][lifetime] with the following exceptions: fabrics and other covering materials, and paper handling products for 3 years, LED drivers/power supplies for 5 years, and electromagnetic ballasts for [2][3] years. Warranties must be signed by the authorized representative of the manufacturer. Present warranties, accompanied by document authenticating the signer as an authorized representative of the guarantor, to the Contracting Officer upon the completion of the project. Guarantee that the workstation products and installation are free from any defects in material and workmanship from the date of delivery. Submit two copies of the warranty.

1.7 MAINTENANCE AGREEMENTS

Collect information from the manufacturer about [maintenance agreement] [green lease] [take back program] options, and submit to Contracting Officer. Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse and avoid landfilling and burning reclaimed materials. When such a service is not available through a manufacturer, local recyclers should be sought after to reclaim the materials.

PART 2 PRODUCTS

2.1 MATERIALS

Provide System Furniture Components with a minimum of 55 percent recycled content. Provide data identifying percentage of recycled content for system furniture components.

Provide certification of indoor air quality for Office Furniture Systems and Seating.

2.2 SYSTEM DESCRIPTION

2.2.1 Workstations

This specification establishes the minimum requirements for the acquisition and installation of a complete and usable system of workstations composed of panels, freestanding work surfaces or base units, supporting components, electrical hardware, communications, special electrical features, and accessories. Provide workstation requirements and configurations in accordance with the furniture layout and typical workstation types shown in drawings and specified herein. Provide components and hardware from a single manufacturer that are standard products as shown in the most recent published price lists or amendments. Proposed product must be part of the manufacturer's current line with no intent to discontinue within two years. Submit complete listing of part/model numbers for all components to be provided, including names and codes of components referenced on updated drawings. Provide electrical components from a single manufacturer to the extent practicable (different types of components may be of different manufacturers, but all units of a given component must be from a single source). Conformance with NFPA 70, UL 1286, NFPA 101, and 36 CFR 1191 is required. Coordinate the work of this section with that to be performed under other sections. This specification may include items which are not manufactured by the furniture manufacturer; provide any such items under this section. Submit two complete sets of certificates attesting that the proposed workstation meets specified requirements. Date the certificate after the award of the contract, include the name of the project, and list specific requirements being certified.

2.2.2 Samples

Submit samples as required to obtain final approval. The Government reserves the right to reject any finish samples that do not satisfy the technical or color requirements. Work can not proceed without sample approval in writing from the Contracting Officer. Submit four sets of the finish samples listed below:

a. Panel, tackboard and overhead door fabric. Minimum 6 by 6 inches with label designating the manufacturer, pattern, color, fiber content, fabric width, fabric weight, fire rating, and use (panel and/or tackboard).

b. Workstation component finishes. Minimum 2-1/2 by 3 inches with label designating the manufacturer, material composition, thickness, color, and finish.

c. Personal Task lights (Not overhead task lights).

d. Panel glazing. Glazing samples with label designating the material and safety ratings.

2.2.3 Mock-up

Submit a Mock-up of an actual workstation reflecting approved finishes and fabrics. Locate the mock-up installation at [the local dealership][approved off-site location][_____]. Do not order product for the project until the mock-up has been approved. Submit manufacturer's product and construction specifications which provide technical data for furniture system and components specified, including task lighting and illumination performance information. Include adequate information in the literature to verify that the proposed product meets the specification. Review of the mock-up may result in adjustments to the product, layout and finishes. The approved mock-up can be used in installation.

2.2.4 Alternate Design

Manufacturers who are unable to provide workstations that conform exactly to the furniture layouts and typical workstation types shown in the contract drawings, may submit alternate designs for consideration by the Contracting Officer. Alternate designs must meet or exceed the following criteria. Alternate designs that are submitted but do not meet these criteria will be rejected. In the alternate design provide workstations and components of the same basic size and configuration shown, with only the sizes of the individual components within the workstation changed to meet the standard product of the manufacturer or site conditions.

2.2.4.1 Component Requirements

Provide the types of components or elements as shown on the drawings and as specified in PART 2 PRODUCTS of this specification. Do not reduce the storage capacity, number of workstations accommodated, width of aisles, or workstation configuration.

2.2.4.2 Wiring Configuration

Provide alternate configurations that support the circuiting and connection capabilities identified under the provisions pertaining to power distribution of paragraph POWER AND COMMUNICATIONS. Generally any alternate will be acceptable which involves only a variation in size or quantity that exceeds the specified configuration.

2.2.5 Performance Requirements

Panels, frames and frame covers, connection system, work surfaces, pedestals, shelf units, overhead door cabinets, lateral files, locks, accessories, and miscellaneous hardware must meet testing as specified. ISO 9001 certified manufacturers may perform in-house testing. Manufacturers not ISO 9001 qualified will be required to produce testing by an independent testing laboratory. Component specific requirements are listed in appropriate paragraphs.

2.2.5.1 Selected Components

Workstation conformance to ANSI/BIFMA X5.5 and ANSI/BIFMA X5.6 is required with the following exceptions: Panels, or panel supported components conformance to ANSI/BIFMA X5.6 is required. Representative items will be selected for testing based on worst case situations (i.e., the deepest and widest work surface or shelf). Perform the keyboard drawer or shelf test applying a 50 lb load to the center of the keyboard shelf for a period of 5 minutes. Any loosening of attachments or damage to the operation of the drawer or shelf will be cause for rejection.

2.2.5.2 Panel Acoustics

Provide acoustical panels with a minimum noise reduction coefficient (NRC) of [0.65] [0.80] [_____] when tested in accordance with ASTM C423 and a minimum sound transfer coefficient (STC) of [14] [20] [24] [26] [_____] when tested in accordance with ASTM E290. Conduct the test on the entire assembled panel, full face area (the complete core, adhesive, decorative fabric, frame and joining components).

2.2.5.3 Panel Glazing

Tempered glass must conform to ANSI Z97.1 and ASTM C1048, Kind FT, Condition A, Type I, [Class 1 Transparent] [Class 3 - Light reducing, tinted or translucent].

2.2.6 Pattern and Color

Provide pattern and color of finishes and fabrics for panel systems, components, and trim [in accordance with Section 09 06 00 SCHEDULES FOR FINISHES] [as shown on the drawings] [_____].

2.3 SYSTEMS FURNITURE

2.3.1 Panel System Components

Supply aaccessories and appurtenances for a completely finished panel assembly with the system. Provide a system capable of structurally supporting cantilevered work surfaces, shelves, files, overhead cabinets, and other components in the configurations shown on the drawings plus more than one fully loaded component per panel per side. Provide panels that are[tackable][or][capable of accommodating fabric covered tackboards,] [acoustical,] [stackable with a system capable of lowering or raising the overall panel assembly height at horizontal connections by removing or adding panel-frames on-site without disturbing adjacent panel components,] [segmented as designated on the drawings]. [Segments will be field removable from both sides of the panel]. [Provide capability for worksurfaces to attach to the panels in 1 - 2 inch increments.] [Provide a spine wall system where electrical and data management will be easily accessible by removable wall covers that can be removed while workstation components are still attached. [Cables must be laid in the system, not threaded through the frame.]] Provide a panel system that is available in a variety of nominal widths and heights as designated on the drawings. Measure heights from the finished floor to the top of the panel. Supply powered and nonpowered panels that are compatible in height. Coordinate panel heights with the HVAC and electrical designs. [Minimum panel thickness is 3 inches thick.] [System to have 100 percent off-modular capability with no defacement of any element caused by components when used in an off-modular application. Unique panel frames must not be required for off modular connections.] Submit three sets of Assembly Manuals describing assembly and reconfiguration procedures.

2.3.2 Panel Finishes

Provide panels in the following options: [safety glazed,] [open frame,] [tackable fabric,] [acoustical fabric,] [wood veneer,] [marker surface,] [paint,] [slat tile,] [perforated metal,] [_____]. [Frame covers may have different options on either side of the frame.] Exposed panel trim to have a [factory baked enamel or epoxy powder] [wood] finish. [Filler trim will either match the panel trim or be fabric covered to match the panel fabric.] [Do not provide filler trim.] Provide each fabric-faced panel with a seamless width of fabric stretched over the entire face of the panel. The fabric color throughout the installation must be consistent. Curved panels may use adhesives on curved sections. Attach the fabric securely and continuously along the entire perimeter of the panel and allow for easy removal and replacement in the field (with the exception of curved panels). Fabric must be factory installed with [   ] panel fabric content.2.3.3 Raceways

Provide raceways and covers as an integral part of the panel whether powered or nonpowered. Magnet held base covers will not be accepted.

2.3.4 Leveling Glides

Provide precise alignment of adjacent panels and include leveling glides to compensate for uneven floors. Provide quantity and location of leveling glides as recommended by the manufacturer. A minimum 3/4 inch adjustment range is required.

2.3.5 Connection System

Provide connectors which accommodate a variety of configurations as indicated on the drawings to include: a straight line connection of 2 panels (180 degrees), corner connection of 2 panels (90 degrees), T connection of 3 panels (90 degrees), cross connection of 4 panels (all 90 degrees),[angle connection of 2 panels (120 degrees),][and a connection of 2 panels for setting the panels at any angle]. Provide tight connections with continuous visual and acoustical seals. Plastic, painted metal, fabric or wood finish connections are required to match system. Provide connector system that allows removal of a single panel within a typical workstation configuration, without requiring disassembly of the workstation or removal of adjacent panels. Provide for connection of similar or dissimilar heights to include trim pieces to finish the exposed edge. Right angle (90 degree) connections between panels must not interfere with the capability to hang work surfaces and other components on any adjacent panel. Provide, as required, the continuation of electrical and communications wiring within workstations and from workstation to workstation. Filler posts must be level with the top rail.

2.3.6 Wall Mounted Panels

Use wall-mount components when it is necessary to attach panels or vertical panel-frame assemblies to the building walls. Provide structural support for wall panels as required. Panels and other systems furniture components are not be wall mounted unless they are included in the original design.

2.3.7 Glazed Panel Inserts

Provide safety glass glazed panel inserts in accordance with ANSI Z97.1 and ASTM C1048. Acrylic glazing will not be accepted.

2.3.8 Door Panels

Provide door panels with a rigid metal frame with rails, a threshold, and a [wood] [laminate] [safety glazed] [_____] clad door adaptable to either hand swing. Allow for a minimum 32 inch clear opening. Include connectors, hinges, and [brushed chrome] [epoxy powder] [baked enamel] finished ADA compliant door knob or handle.

2.3.9 Sliding Doors

Attach sliding or rolling doors to the panel as shown on the drawings. Provide doors that the direction in which the door slides can be changed in the field. Supply ~~[~~translucent~~][_____]~~ door in same width or wider than the opening to be covered. Provide door pulls for each side of door. Door frame to match the panel frame color.

~~2.4 DESK-BASED SYSTEM~~

~~Supply accessories and appurtenances for a completely finished desk-based assembly within the system. Provide a desk-based system that is free-standing, independent of panel system support and capable of structurally supporting work surfaces, shelves, and other components in the configurations shown on the drawings. Provide a variety of nominal widths and depths as indicated on drawings.~~

2.4 WORK SURFACES

2.4.1 Construction

Construct work surfaces to prevent warpage. [Fully support work surfaces from the panels or support jointly by the panels and supplemental legs, pedestals, or furniture end panels. Use supplemental end supports only under work surfaces when the work station configuration does not permit full support by the panels. Use metal support brackets to support work surfaces from the panels, provide metal-to-metal fitting to the vertical uprights of the panels, vertically adjustable, to lock the work surfaces in place without panel modifications.] [Support work surfaces with legs, pedestals, or furniture end panels.] Abutting work surfaces must line up closely and be at equal heights when used in side-by-side configurations in order to provide a continuous and level work surface. Provide pre-drilled holes to accommodate storage components, pedestals and additional supports in work surfaces, or drill holes at the job site to accommodate these items. Provide work surfaces in sizes and configurations shown on the drawings. Provide work surfaces in nominal depths of [20 inches,][and][24 inches,][and][30 inches,] plus or minus 2 inches, nominal lengths from 24 to 72 inches, and a nominal thickness from 1 to 1-3/4 inches. [Provide height adjustable work surfaces from 25 to 52 inches above the finished floor with a [crank-based][mechanical][electrical] control.] Provide [corner,] [peninsula,] [and][counter/transaction] work surfaces as shown on the drawings and include hardware necessary to provide firm and rigid support.[Work surfaces must have 100 percent off-modular capability with no defacement of any element caused by components when used in an off-modular application.][Provide mobile half round table to include casters of which a minimum 2 must be locking[, and table must lock to the adjacent worksurface].]

2.4.2 Finishes

Provide work surfaces with a finished top surface of [high pressure plastic laminate], [veneer] and a smoothly finished underside. The work surface must not be damaged by ordinary household solvents, acids, alcohols, or salt solutions. Provide metal support brackets that match the color and finish of trim. Provide [PVC] [ABS] [laminate] [solid wood] [wood veneer] [synthetic wood] edges

2.5 PEDESTALS

Provide drawer configurations and pedestal height as shown on the drawings. Provide the deepest possible pedestal for each work surface size specified. Free standing mobile pedestals to include an attached upholstered seat cushion, a handle for moving, and casters. Mobile pedestals must be load bearing and equipped with counterbalance as standard. Provide appropriate height of mobile pedestal so it can be stored under a standard height worksurface.

2.5.1 Construction

Provide pedestals and drawers of steel construction[with the exception of drawer fronts]. Securely attach drawer faces to the drawer front.

2.5.2 Finishes

Provide a factory baked enamel finish or powder coated for steel surfaces. Provide [steel][plastic laminate][molded plastic][veneer] drawer fronts.

2.5.3 Drawer Requirements

Pedestals must be field interchangeable from left to right, and right to left, and must retain the pedestal locking system capability. Design pedestals to protect wires from being damaged by drawer operation. Provide pedestals that support work surfaces,. Drawers must stay securely closed when in the closed position and provide each drawer with a safety catch to prevent accidental removal when fully open. File drawers to be provided with full extension ball bearing drawer slides or rack and pinion suspension. File drawers to be provided with hanging folder frames or rails and capable of hanging side-to-side or front-to-back. [Provide dividers with vertical files.]
[Provide box drawers with pencil trays.] [Provide center pencil drawer and mount under the work surface.]

2.6 STORAGE

Provide storage units in the sizes and configurations shown on the drawings. [Provide task lights under overhead cabinets][and][shelf units]. Depth to accommodate [a standard three ring binder][_____][Panel attached storage is required to have 100 percent off-modular compatibility with no defacement of any element caused by components when used in an off-modular application.]

2.6.1 Shelf Unit Construction

Provide metal construction shelf pan with formed edges. Provide shelf supporting end panels of metal, high density particle board, molded phenolic resin, or molded melamine. Provide relocatable shelf dividers with shelf units.

2.6.2 Overhead Cabinet Construction

Provide metal construction overhead cabinets. Provide doors with a suspension system. [Provide overhead cabinet door that retracts over the top of the cabinet[and is curved].][Provide overhead cabinet door that retracts into the cabinet.] [Provide upmounted overheads.] [Provide sliding doors on overheads.] [Overhead cabinet must be ADA accessible.]

2.6.3 Lateral File[, Vertical File][and Book Case] Construction

Provide units and file fronts, top and end panels of steel construction. File drawers to be provided with full extension ball bearing drawer slides or rack and pinion suspension. File drawers to be provided with hanging folder frames or rails and capable of hanging side-to-side or front-to-back. [Provide dividers with vertical files.]

2.6.4 Personal Storage Tower Construction

Provide personal storage tower and components of steel construction. Height of the unit to be [the same height as the surrounding panels][_____]. The personal storage tower will include one full height wardrobe unit with coat rod, two file drawers, bookcase with two adjustable shelves, [_____] and hinged lockable doors.

2.6.5 Finish

Provide a factory baked enamel or epoxy powder coat finish for shelves, dividers and top dust cover. Provide either a factory baked enamel, epoxy powder coat or laminate finish for shelf supporting end panels. Shelf bottom is required to match end panel color. Provide metal doors with an exterior finish of factory baked enamel and an interior finish of factory baked enamel or epoxy powder coat. Provide a factory baked enamel finish or epoxy powder coat on metal drawers. [Provide a wood veneer surface on [overhead cabinets] [pedestals] [book cases] [towers],[and] [lateral files].]

2.7 ACCESSORIES

2.7.1 Coat Hook

Provide one mounted coat hook per workstation.

2.7.2 Keyboard Tray

Provide work surfaces that are capable of accepting an articulating keyboard in locations as shown on the drawings. The keyboard tray must be capable of fully recessing under the work surface and extending to give the user full access to the keyboard. Provide height adjustability, 180-degree swing side travel rotation and negative tilting capability. Include a wrist support and a mouse pad at the same level as the keyboard tray to accommodate either right or left-handed users.

2.7.3 Tackboards

Fabric must be factory installed. Provide [ ] fabric content of tackboards. Location and size [as shown on the drawings][_____].

2.7.4 Erasable Marker Boards

Provide marker boards with a white writing surface that can be easily written on and erased and unaffected by common marker board cleaning/conditioning agents. Include a storage tray and minimum two markers with the markerboard. Size and location [as shown on the drawings][_____].

2.7.5 Paper Management Unit

Provide paper management units as indicated [on the drawings] [_____]. Construct these units of coated steel or injection molded plastic to accommodate either legal or letter size lengths.

2.7.6 Wall Mounted Components

Provide wall tracks when components are shown attached directly to wall surfaces. Provide tracks of heavy duty extruded metal with finish and color matching the the panel trim. Provide vertically aligned tracks slotted on 1 inch centers in heights required that match slot spacing for components.

2.7.7 CPU Holder

Provide a mounting to support the computer hard drive. Desk top and floor locations are not acceptable.

2.7.8 Signage

Provide [panel mounted][_____] signage composed, at a minimum, of aluminum frame, back panel, clear plastic cover, and hanging device. Provide signage approximately[3 by 8 inches][_____] and capable of receiving a replaceable [standard white][_____] paper insert. Match [_____]text type.[Include name of occupant on signage for each workstation with names provided by customer prior to installation [_____].][Provide software for creating text in PC computers for owner production of replacement paper inserts after project completion.]

2.7.9 Slat Tile

Provide slat tile with channels to accommodate attachments such as monitor arm, task light and organizer accessories. Provide maximum slat tile height of 16 inches and a length ~~[as shown on the drawings][_____]~~48 inches. Slat tile must be integral to the panel and not attached to the surface of the panel. ~~[Provide slat tile that is able to support the weight of two monitor arms and two flat panels simultaneously.]~~

~~2.7.10 Monitor Arm~~

~~Provide monitor arm that allows 360 degree monitor rotation for portrait and landscape viewing, and 60 degree range of lateral and vertical monitor tilt for additional viewing adjustability. Provide monitor arm that supports monitors weighing[7 to 19 lbs][_____]. [Provide [dual monitor arm for 2 screens] [   ].] Mount monitor arm on [slat walls][work surface].~~

2.8 MISCELLANEOUS HARDWARE

Provide brackets, supports, hangers, clips, panel supported legs, connectors, adjustable feet, cover plates, stabilizers, and other miscellaneous hardware that contribute to a complete and operable furniture system.

2.9 LOCKS AND KEYING

Provide ~~[~~overhead cabinets,~~][vertical files,][personal storage towers,]~~ pedestals and lateral files with keyed locks, unless otherwise noted. Provide field changeable lock cylinders with a minimum of 20~~[100] [_____]~~ different key options. Key each workstation individually, and key locks alike within a workstation. Provide lockable drawers within a pedestal either by a central lock that controls all pedestals under one work surface or an individual keyed lock in each pedestal. Key alike central file and storage units which are grouped together but are not a part of a workstation unless otherwise specified. Provide two keys for each lock or two keys per workstation when keyed alike, and provide three master keys per area as indicated. Number keys and lock cylinders for ease of replacement. Clearly label locks with a key number, except for those manufacturers who have removable format locks. ~~[~~Provide door panels with keyed ~~[door knob][_____]~~ latch set with lock.~~]~~

2.10 POWER AND COMMUNICATIONS

Provide ~~both powered and~~ nonpowered panels with base raceways capable of distributing power circuits, ~~[~~communication cables~~]~~ ~~[~~and~~]~~ ~~[~~data lines~~]~~. Provide nonpowered bases that are capable of easy field conversion to powered base without requiring the panel to be dismantled or removed from the workstation. ~~[~~Provide panels able to support lay-in cabling and having a large capacity for power and data. Provide ample space for storing excess wires and fiber optic cables in the interior of the spine wall frame. Provide easy access to power and data systems in the spine wall without having to move return panels or components. Power, voice, and data shall come from the adjacent walls via finished (all edges) open frame panels. The open frame shall be completely enclosed. ~~Provide the ability for the spine wall system to supply power to a wall-attached panel system and/or an adjacent desk system. A termination center or utility closet may be utilized in the wall or at the end of a panel run.] Provide copper [cable assemblies,] [wiring harnesses][or][electrified bus] for the system and meet the requirements of UL 1286 and NFPA 70, Article 605. Provide conductors with 20 amp [90] [75] degree C, #12 AWG wires (unless indicated otherwise) or the equivalent in the bus configuration. A single circuit must not serve more than four (4) cubicles or workstations under any circumstances. The label or listing of Underwriter's Laboratories, Inc. will be accepted as evidence that the material or equipment conforms to the applicable standards of that agency. In lieu of this label or listing, submit a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures of UL and that the materials and~~

~~equipment comply with contract requirements. Electrical work not addressed in this section must conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.~~

2.10.1 Panel Raceways

Provide panels that have hinged or removable covers that permit easy access to the raceway when required but are securely mounted and cannot be accidentally dislodged under normal conditions. Place raceways in locations such as the base, beltline, and below and above the beltline. The raceway must not extend past either ~~[~~panel face~~]~~ ~~[frame cover]~~ by more than 1/2 inch. Provide metal or plastic covers which attach securely to the raceway as required and match the finish and color of the panel trim. Provide a minimum of 2 knockouts (doors) per side for power receptacles and communications jacks as indicated in raceways ~~[~~in full size over 24 inches powered panels~~]~~ ~~[~~on panel frames~~]~~. Provide other raceways that are flush with ~~[~~panel face~~][frame covers]~~.

~~2.10.2 Power Distribution~~

~~Provide power distribution as indicated on the drawings. Provide an internal [power][and][communications] raceway and the capability of disconnecting and connecting external circuits to the electrified raceway in the panel. Capacity for at least [six][twelve][twenty] 4-pair category 6 cables is required for the communications receiving raceway. Power and communications wiring may share a common wireway if a metal divider is included to ensure electrical isolation. Provide doors or access openings for entry of communications cable. Provide the electrified power raceway for the [10-wire][8-wire][6-wire][or][5-wire] configuration indicated.[Unless otherwise indicated, allocate conductors of the 8-wire system as follows: the three-phase system will have one equipment ground, one isolated ground, [one neutral] [one oversized (133 percent minimum) neutral], and two each dedicated phase.][Unless otherwise indicated, allocate conductors of the 8-wire system as follows (4-2-2 shared neutrals, 2+2): the three-phase system will have one equipment ground, one isolated ground, two oversized (133 percent minimum) neutral, and four phase conductors; each neutral will be used by two phase conductors, no neutral conductor will be connected to multiple phase conductors of the same phase, and no ground conductor will be on the same circuit as two phase conductors from the same phase; circuits sharing a given neutral conductor will share the same ground conductor.][Unless otherwise indicated, allocate conductors of the 8-wire system as follows (4-2-2 shared neutral plus dedicated circuit, 3+1): the three-phase system will have one equipment ground, one isolated ground, two oversized (133 percent minimum) neutral, and four phase conductors; one neutral will be dedicated to a single phase conductor, one neutral will be shared by three phase conductors, and no neutral conductor will be connected to multiple phase conductors of the same phase; the isolated ground conductor will use by the circuit with the dedicated neutral conductor and the equipment ground conductor will use by the circuit with the shared neutral conductor.]~~
~~[Unless otherwise indicated, allocate conductors of the 8-wire system as follows (3-3-2 independent neutrals, 2+1): the three-phase system will have one equipment ground, one isolated ground, three neutral, and three phase conductors; one neutral will be dedicated to each phase conductor; the isolated ground conductor will use by one circuit and the equipment ground conductor will use by the other two circuits.]~~
~~[Unless otherwise indicated, allocate conductors of the 10-wire system as follows (6-2-2 shared neutrals, 3+3): the three-phase system will have one equipment ground, one isolated ground, two oversized (133 percent~~

~~minimum) neutral, and six phase conductors; each neutral will be shared by three phase conductors and no neutral conductor will be connected to multiple phase conductors of the same phase; circuits sharing a given neutral conductor will share the same ground conductor.]~~
~~[Unless otherwise indicated, allocate conductors of the 10-wire system as follows (4-4-2 independent neutrals, 3+1): the three-phase system will have one equipment ground, one isolated ground, four neutral, and four phase conductors; one neutral will be dedicated to each phase conductor; the equipment ground conductor will be shared by three circuits, the isolated ground will be dedicated to the other circuit, and no ground conductor will be on the same circuit as two phase conductors from the same phase.]~~
~~[Unless otherwise indicated, allocate conductors of the 10-wire system as follows (4-4-2 independent neutrals, 2+2): the three-phase system will have one equipment ground, one isolated ground, four neutral, and four phase conductors; one neutral will be dedicated to each phase conductor; one ground conductor will be shared by two circuits, the other ground will be shared by the other two circuits, and no ground conductor will be on the same circuit as two phase conductors from the same phase.]~~

~~2.10.2.1 Receptacles~~

~~Provide power receptacles in the powered panels. Place devices at the locations indicated on the plans connected to the designated circuits. [Electrical power receptacles and communications jacks should have the ability to be hung at [8 inch] [multiple] [_____] vertical increments throughout the frame via power harnesses.] Unless otherwise indicated, receptacles must be [15 amp (NEMA 5-15R)] [20 amp (NEMA 5-20R)] commercial grade conforming to NEMA WD 1 and NEMA WD 6. Provide 10 percent spare devices of each type shown on these plans if receptacles are not interchangeable or will not permit field adjustment of phase and circuit selection. [All][General use] receptacles are required to be of the duplex configuration; unless otherwise indicated, special use receptacles are required to be of the simplex configuration with the blade/pin arrangement identified on the plans. Coordinate the color of receptacle bodies with the color of the panel trim. Isolated ground receptacles must [be orange] [or] [have distinct markings][be of a different color than other receptacles]. Furniture receptacles whose building power supply circuit is controlled by an energy management system, timer, or some other automatic means or are provided with local automatic control, will be identified using the standard symbol shown in NFPA 70 Figure 406.3(E); identify each outlet on a multi-outlet receptacle individually. Provide field applied identification that is permanent; stick-on or non-setting adhesives are not acceptable. Provide [5][_____] percent spare devices for each configuration and type of receptacle. Provide a minimum of [5][_____] receptacle removal tools for systems that require special tools for proper receptacle removal.~~

~~2.10.2.2 Power Cabling Variations~~

~~The paragraph Power Distribution has identified specific cabling configurations. Since universal conventions have not been established, variant configurations available from various manufacturers will be considered. Provide alternates that allow the same circuiting, device connections, neutral and ground separation, and upstream feeder connections as shown on the plans. See paragraph ALTERNATE DESIGN. An example of an acceptable variation includes the use of a manufacturer's configuration which allocates individual conductors differently, but which has the same quantity of conductors and allows devices to be physically~~

~~connected in the field as shown on the plans. It is not necessary that the manufacturer's labeling codes or terminology match the designations used on project plans or in the specifications; however, color code insulation for neutrals and grounds per standard practice or provide with tags, colored tape, colored ribbons or similar identification. (The reference to "dedicated" conductors in this specification pertains to circuit connections upstream and load connections downstream of panels; it is not necessary that manufacturer's designations correspond.)~~

~~2.10.3 Electrical Connections~~

~~2.10.3.1 Internal Connections~~

~~Utilize [straight or flexible plug/receptacle connector assemblies] [hardwired connections] for internal panel-to-panel power connections and provide the powered configurations shown on the drawings.~~

~~2.10.3.2 Connections to Building Services~~

~~Supply external [power][and][communications] services to the panels via [direct-wired [top][base] entry modules.][hard wired [top][base] entry junction box assemblies.][Extend wiring from building services to the entry modules or panel bases in metal conduit or tubing or in flexible liquidtight conduit 6 foot maximum.][Extend wiring from building services to junction box assemblies in metal conduit or tubing. Provide wiring from junction boxes that is flexible liquid-tight conduit 6 foot maximum or in metal conduit or tubing.] Do not use cord and plug assemblies for any portion of external links.[Provide base feed modules that plug into the end or either side of the raceway at receptacle doors.][Top entry [modules][junction box assemblies] are required to extend the [power][and][communications] wiring into service entry poles attached to the electrified panels.] External wiring must conform to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.~~

2.10.2 Wire Management

Provide wire management capability at all workstations and accommodate all cable types specified, including the applicable manufacturer required bending radius at corners. Design raceways and interfaces to the raceways to accommodate the bend radius as shown in TIA-569 for Category ~~[~~6~~][~~6A~~][~~7 ~~][______][~~ and ~~][~~fiber optic cables~~]~~ communication wiring ~~[~~whichever is greater~~]~~. Provide copper and fiber cabling meeting the requirements of Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. The capability may be accomplished by cable access cutouts (1 minimum per work surface), covered wire management troughs in vertical end panels, horizontal wiring troughs, internal midpanel (beltline) raceways, or rear gaps (between the back edge of the work surface and the facing support panel). Provide grommet kits or another suitable finish arrangement for all cable cutouts. Provide accessories for an externally mounted vertical and horizontal wire management and concealment system ~~[as indicated on the contract drawings] [~~as recommended by the manufacturer~~]~~. Supply horizontal wire managers for mounting under all work surfaces. Attach the wire managers either to the underside of the work surface or to the vertical panel without damaging the face. Exposed or loose wiring will not be acceptable. Wire managers must be prefinished and secure, conceal, and accommodate outlet cords as well as electrical and communications wiring. Wire channels are required to match color of panel trim, attach by means of clip-on attachment, and conceal wires routed vertically.

Separate power wiring from communication wiring by use of separate raceways or by placement of channels in joint use troughs or wireways.

~~2.10.3 Circuit Layout~~

~~Provide the circuit layout for workstations on the drawings. Connect devices to the designated circuits in the neutral, ground, and automatic control configurations indicated. Connections must be made to the building electrical distribution system as shown on the contract drawings and in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.~~

~~2.10.4 Service Entry Poles~~

~~Provide service poles, as indicated on the contract drawings, and capable of minimally accommodating the [8-wire][10-wire][_____] power configuration and the equivalent of [six][twelve][twenty] 4-pair category 6 cables.[Poles musthave metal barriers or channels to separate power and communications wiring.] Pole dimensions can be equal to maximum panel thickness. Designated poles are required to have the capability of being opened along the vertical access to permit the lay-in of wiring. Provide each pole with a wiring interface, an end cap and a ceiling trim plate which extends a minimum of 1-1/2 inches from all sides of the pole. Include a junction box either as part of the pole assembly or in a field installed configuration with poles for power service. Service poles must be securely attached to the panels and installed plumb. Provide wiring and interface components as required to connect the building power supply to power poles.~~

~~2.10.5 Task Lighting~~

~~Provide task lights with [linear fluorescent lamp][light emitting diode (LED) technology] to include a built-in reflector and shielding device that prevents direct glare into an occupant's eyes when they are in a typical working position. [Provide adjustable arm task lights with adjustable, fully articulated and balanced head and arms, minimum 10 inch adjustable arm range, linear, circular, or compact fluorescent lamp technology, cord set for plug in, built in reflector, that is [panel mounted][desk mounted][freestanding][_____].] Provide task light size and placement on the contract drawings. It is required that lights be a standard component of the manufacturer's workstation products, and the ends of the task light length can not extend beyond the edges of the overhead cabinet. Enclose task light power cords within vertical wire cover or clips. Provide UL approved luminaires for use in the configurations indicated on the drawings.Provide task lighting that is Energy Star labeled. Provide data identifying Energy Star label for task lighting.~~

~~2.10.5.1 Luminaire Configuration~~

~~Provide luminaires and lamps as specified in Section 26 51 00 INTERIOR LIGHTING and modified herein. For undershelf or undercabinet lighting, provide luminaires that are [linear fluorescent lamp][light emitting diode (LED)] type and have prismatic lenses, baffles, or other shielding device configured to minimize glare by shielding the lamp from view of the seated user.[For adjustable arm task lights, provide luminaires that are linear, circular, or compact fluorescent lamp or LED type and have prismatic lenses, baffles, or other shielding device configured to minimize glare by shielfing the lamp from view of the seated user.] For fluorescent-type luminaires, provide built-in reflectors. Provide task~~

~~lights for each workstation with a minimum of [[810][650] lx][[75][60] footcandles] of light (horizontally measured) without veiling reflections, on the work surface directly below and a maximum of [500mm][20 inches] from the luminaire. Easily removable diffusers, grilles, or other coverings are required to allow for cleaning and relamping.[Use F32T8 lamps in [1220 mm][4 foot] units for fluorescent-type task lighting.][For LED-type task lighting, power consumption exceeding 8 watts per foot is prohibited.] Match Correlated Color Temperature (CCT) of task lighting to the CCT of the ambient room lighting. Provide an easily accessible on-off switch and one ballast or driver per luminaire. A variable intensity control is acceptable if the low setting is equivalent to "off" with zero energy consumption. Multiple level switching is also acceptable.[For fluorescent type technology, do not use ganged luminaires or shared ballasts.][For LED type technology, ganged luminaires or shared drivers are permitted for up to 4 continuous feet in length. A single driver designed for use with an individual LED housing of greater than 4 feet in length is allowed.]~~

~~2.10.5.2 Wiring~~

~~Provide each luminaire with a 6 foot minimum, factory installed, heavy duty electrical cordset with a grounded plug for luminaries that are mounted on the same wall as the receptacle. Provide luminaires mounted on non-powered wall with a 9 foot minimum, factory installed heavy duty electrical cordset with a grounded plug. Direct or hard wire connections are not acceptable. Unless otherwise indicated, conceal cord. Built-in cord concealment is required within panels or utilize field installed, manufacturer approved accessories. Cords may be extended through dedicated channels located at any point within panels or may be placed in vertical slots or in the space between panels if held in place by retainers and concealed by a cover plate. Vertical wire managers are required to be prefinished and cut to size and to extend from the task light level down to the top of the work surface below the task light. Attach each manager to a panel vertical edge or connector strip without damage to the surfaces.~~

~~2.10.5.3 Control Device~~

~~[Provide task lighting with an automatic shutoff control device integral to the luminaires.][Provide occupancy sensors with "manual ON", "automatic OFF" controls for luminaire control.][For furniture with automatically-controlled building supply power circuits, connect task lighting to an automatically-controlled circuit.][Provide task lighting with a manual ON/OFF switch.]~~

~~2.10.6 Communications~~

~~Communications wiring will be extended to, and installed in, the electrified panels as shown on the plans. Install communications jacks at designated locations.[Provide a communication consolidation point at the end of the cubicle. The consolidation point will consist of a [24][48] port patch panel that is rated for Category [6][6A][7]. The panel that covers the consolidation panel is required to be lockable with all locks keyed alike. These locks must not be keyed the same as any other item associated with the workstations.] Communications work may be performed in conjunction with the installation of workstations or may be separately executed at the Contractor's option; however, equipment, materials, and installation must conform to the requirements of [Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM] [Section 27 10 00 BUILDING~~

~~TELECOMMUNICATIONS CABLING SYSTEM][_____], and properly coordinate all interfaces.~~

~~2.10.7 Special Systems~~

~~Provide management for secure and nonsecure power, computer and telecommunications cabling through designated raceway systems. Separate secure distribution from nonsecure distribution [in accordance with details shown on the plans][by running secure lines along top located raceway and nonsecure along the bottom of the workstation panel].~~

PART 3 EXECUTION

3.1 INSTALLATION

Install the workstations using certified installers in accordance with manufacturer's recommended installation instructions. A licensed electrician is required to hardwire the workstations. Install workstation components level, plumb, square, and with proper alignment with adjoining furniture. Securely interconnect and attach components to the building where required. Provide three sets of special tools and equipment necessary for the relocation of panels and other components. Verify that equipment is properly installed, connected, and adjusted.

3.2 CLEANING

Provide cleanup as specified in Section 01 78 00 CLOSEOUT SUBMITTALS. Upon completion of installation, clean and polish all products and leave the area in a clean and neat condition. Any defects in material and installation are required to be repaired, and damaged products that cannot be satisfactorily repaired are required to be replaced. Submit three sets of Maintenance Manuals describing proper cleaning and minor repair procedures.

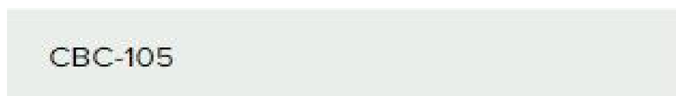
-- End of Section --

ORDER DATA SHEETS

ORDER DATA SHEETS FOR ACCESSORIES

LOCATION CODES: A1, AP1, AP2, AP3, AP4

1.	**Location Code:**	**A1**
2.	**Basis of Design Product:**	**Markerboard**
3.	**Room Name/ Number:**	**Quantity:**
4.	**Workstations - 104**	**1**
5.	**Analysis Room - 118**	**1**
6.	**Analysis Room - 119**	**1**
7.	**Breakout Room - 125**	**1**
8.	**Total Quantity:**	**4**
9.	**Freight:**	**FOB Destination**
10.	**Part Description:**	Provide glass magnetic markerboard made of high-quality 1/4" starphire low iron tempered safety glass with polished edges. No visible hardware. Include (8) black rare earth magnets. Must be Greenguard Certified. Install in landscape format. Provide 2 sets of 8 dry erase markers with magnetic marker holder and magnetic eraser.
11.	**Dimensions:**	96" x 48"
12.	**Finishes:**	CBC-105

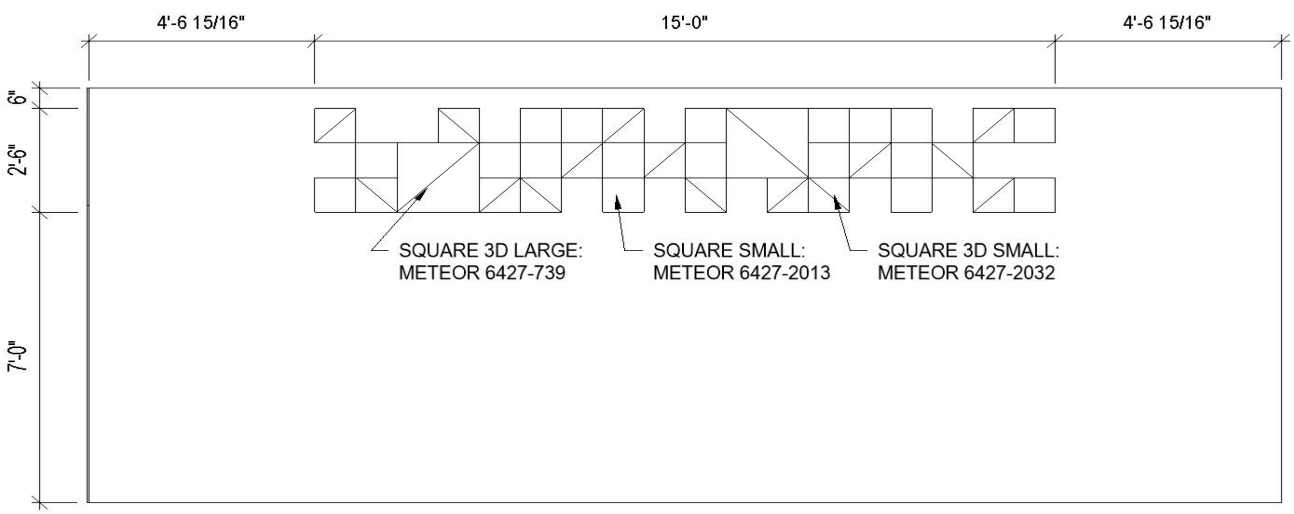


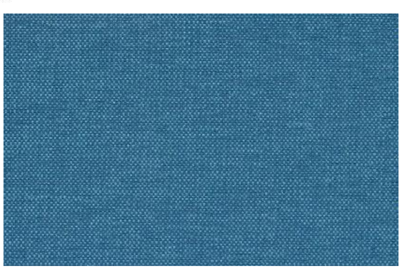
end of order

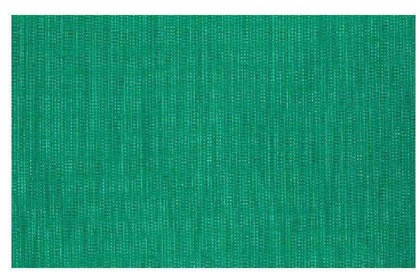
1. **Location Code:** **AP1**
2. **Basis of Design Product:** **Carnegie - Artform Acoustical Panels**
3. **Room Name/ Number:** **Quantity:**
4. **Analysis Room - 119** **1**
5. **Total Quantity:** **1**
6. **Freight:** **FOB Destination**

7. **Part Description:** Provide acoustical panels in the sizes indicate below ad on sheet I-201. Colors shall be as indicated below. Panels below represent a 3d panel either in a 24" or 6" square size.

8. **Dimensions:** 15'-0" x 2'-6"H
9. **Finishes:** Square Small: Carnegie Meteor 6427-2013
Square 3D Small: Carnegie Meteor 6427-2032
Square 3D Large: Carnegie Meteor 6427-739





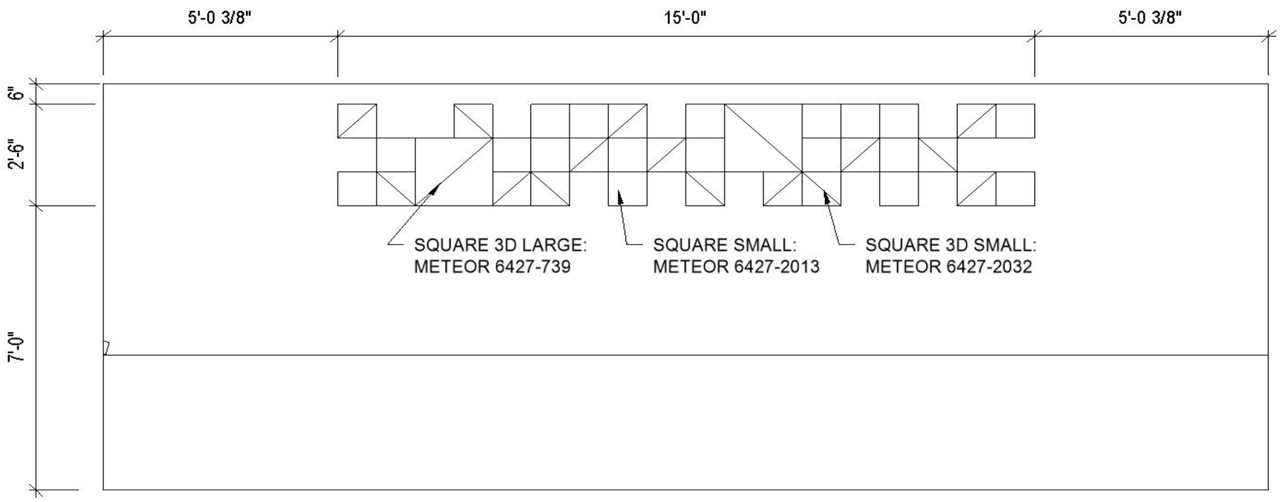


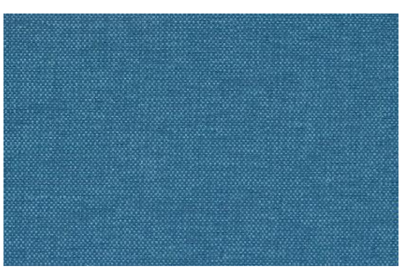
end of order

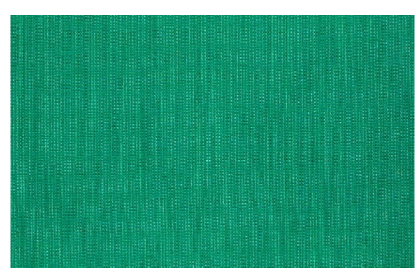
1. **Location Code:** **AP2**
2. **Basis of Design Product:** **Carnegie - Artform Acoustical Panels**
3. **Room Name/ Number:** **Quantity:**
4. **Analysis Room - 118** **1**
5. **Total Quantity:** **1**
6. **Freight:** **FOB Destination**

7. **Part Description:** Provide acoustical panels in the sizes indicate below ad on sheet I-201. Colors shall be as indicated below. Panels below represent a 3d panel either in a 24" or 6" square size.

8. **Dimensions:** 15' x 2'-6"H
9. **Finishes:** Square Small: Carnegie Meteor 6427-2013
Square 3D Small: Carnegie Meteor 6427-2032
Square 3D Large: Carnegie Meteor 6427-739





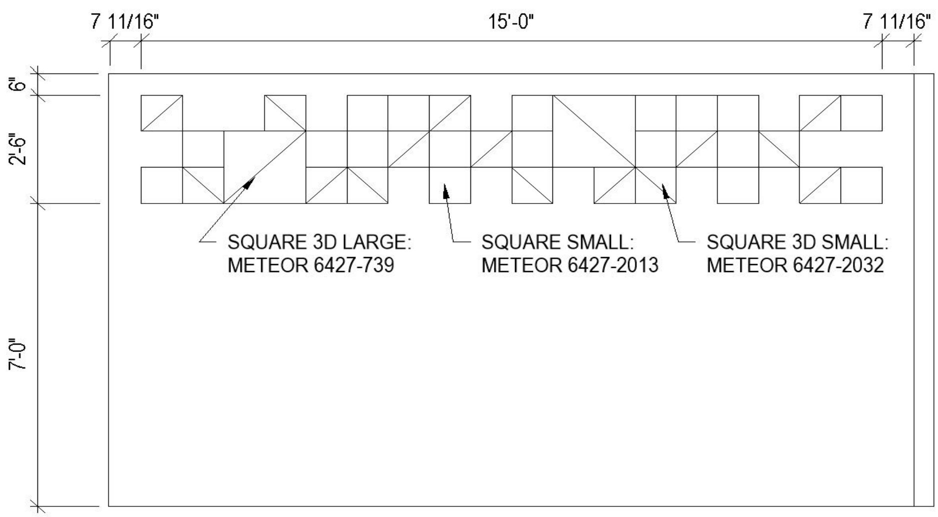


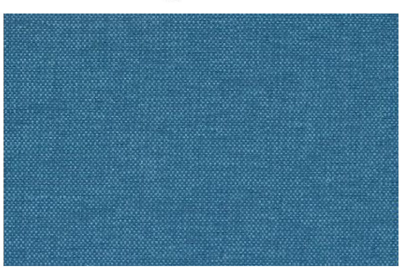
end of order

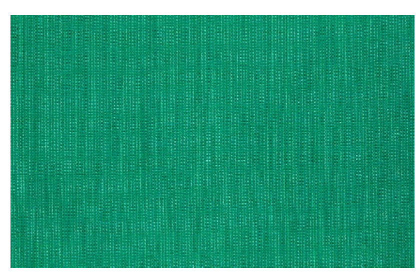
1. **Location Code:** **AP3**
2. **Basis of Design Product:** **Carnegie - Artform Acoustical Panels**
3. **Room Name/ Number:** **Quantity:**
4. **Breakout Room - 125** **1**
5. **Total Quantity:** **1**
6. **Freight:** **FOB Destination**

7. **Part Description:** Provide acoustical panels in the sizes indicate below ad on sheet I-201. Colors shall be as indicated below. Panels below represent a 3d panel either in a 24" or 6" square size.

8. **Dimensions:** 15'-0" x 2'-6"H
9. **Finishes:** Square Small: Carnegie Meteor 6427-2013
Square 3D Small: Carnegie Meteor 6427-2032
Square 3D Large: Carnegie Meteor 6427-739





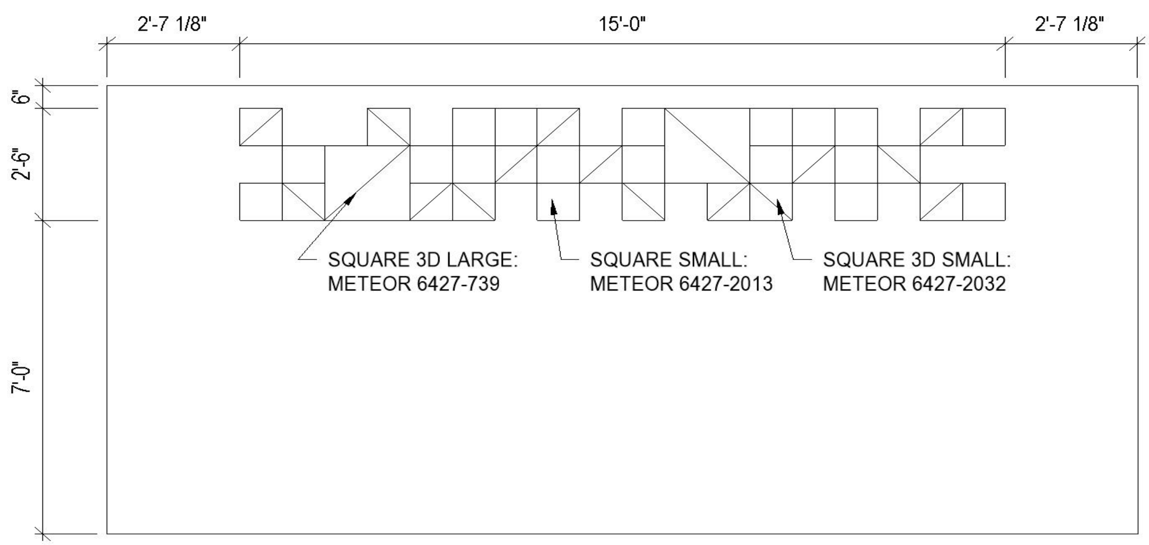


end of order

1. **Location Code:** **AP4**
2. **Basis of Design Product:** **Carnegie - Artform Acoustical Panels**
3. **Room Name/ Number:** **Quantity:**
4. **Breakout Room - 126** **1**
5. **Total Quantity:** **1**
6. **Freight:** **FOB Destination**

7. **Part Description:** Provide acoustical panels in the sizes indicate below ad on sheet I-201. Colors shall be as indicated below. Panels below represent a 3d panel either in a 24" or 6" square size.

8. **Dimensions:** 15'-0"W 2'-6"H
9. **Finishes:** Square Small: Carnegie Meteor 6427-2013
Square 3D Small: Carnegie Meteor 6427-2032
Square 3D Large: Carnegie Meteor 6427-739



end of order

ORDER DATA SHEETS FOR SEATING

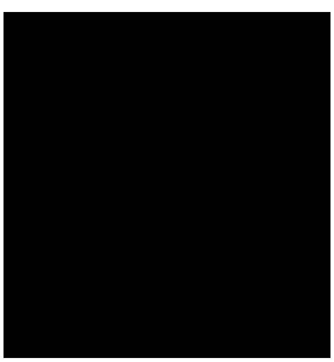
LOCATION CODES: C1, C2, C3

1. **Location Code:** C1
2. **Basis of Design Product:** **Teknion Around Ergonomic Chair with Upholstered Back**
3. **Room Name/ Number:** **Quantity:**
4. **Workstations - 104** **12**
   Analysis Room 4 - 118 **6**
   Analysis Room 5 - 119 **6**
   Mezzanine - 201 **1**
5. **Total Quantity:** **25**
6. **Freight:** FOB Destination

7. **Part Description:** Provide ergonomic sit-to-stand stool with upholstered seat and back. Unit to be fully upholstery wrap the upper back of the seat back with a molded back shell. Seat to have passive edge angle with a seat perimeter made of flexible elastomer. Stool to have adjustable seat depths, pneumatic adjustment mechanism, and back tension adjustment. Stool to have 5-star base with hard dual wheel casters and adjustable footring. Chair shall have 275 lb. seat capacity.Chair shall meet ANSI/BIFMA Requirement

8. **Dimensions:** Overall: 22-3/8" to 34-5/8"W x 21" to 23-5/8"D x 47-3/8" to 55-5/8"H
9. **Finishes:** Seat Upholstery: Fine Grain: Luum 4046-11 Fine Grain Deep Indigo
   Back Upholstery: Fine Grain: Luum 4046-11 Fine Grain Deep Indigo
   Back Shell: Ebony
   Base: Black

UPHOLSTERY

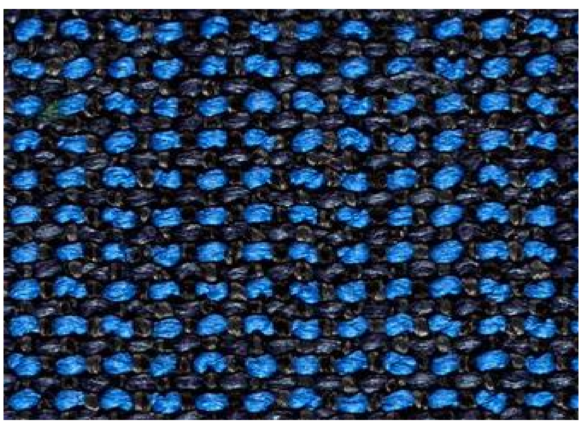


BASE FINISH

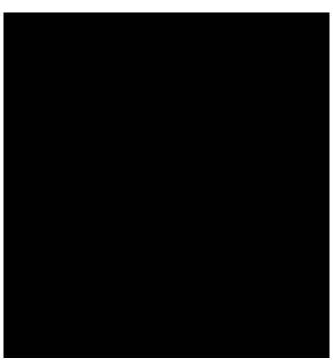
PHOTO VARIES FROM PRODUCT SPECIFIED - BASE IS TO BE BLACK

end of order

1. **Location Code:**	**C2**
2. **Basis of Design Product:**	**Global Furniture - Layne Guest chair**
3. **Room Name/ Number:**	**Quantity:**
4. **Conference - 122**	**25**
5. **Total Quantity:**	**25**
6. **Freight:**	FOB Destination
7. **Part Description:**	Provide a wood-framed guest chair with a fully upholstered seat and back. The frame is to be made of solid European beech constructed using mortise and tenon joinery, steam bent back with passive ergonomic support, and tapered legs. Other joinery used is glue and corner blocks, dowels, screws or staples depending on condition. The seat is constructed with 1.5" premium grade foam @ 50 lb Compression 2.3 Density. The back is fabricated with .75" Premium grade foam @ 42lb Compression 1.8 Density.The chair shall have glides. The chair is fabricated from a hardwood plywood seat covered with polypropylene webbing. The back is a solid hardwood panel. The arms are solid hardwood.
8. **Dimensions:**	Overall: 22-3/20"W x 22-3/4"D x 32"H
9. **Finishes:**	Frame: BKM Black on Maple Seat Upholstery: Luum Macrotweed Galena Back Upholstery: Wood slat finish



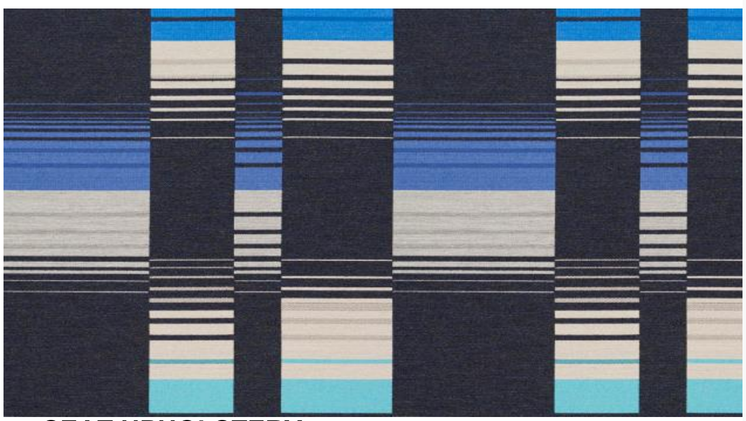
SEAT UPHOLSTERY



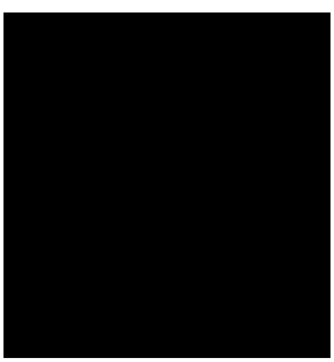
FRAME FINISH

end of order

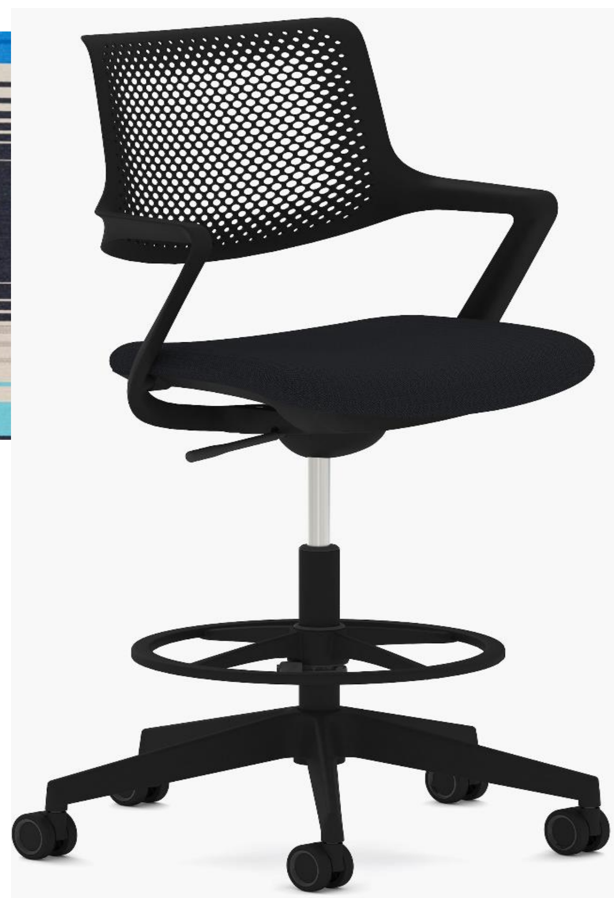
1. **Location Code:** C3
2. **Basis of Design Product:** **National Picado Stool**
3. **Room Name/ Number:** **Quantity:**
4. **Breakout Room - 125** **20**
   Breakout Room - 126 **20**
5. **Total Quantity:** **40**
6. **Freight:** FOB Destination
7. **Part Description:** Provide stool with flex perforated back and upholstered seat. Stool to have adjustable seat depthsand pneumatic adjustment mechanism. Stool to have 5-star base with hard dual wheel casters and adjustable footring. Seat cushion is 2" molded, CFC-free , urethane foam. Designed and tested for up to 350 lbs. Upholstery repeat is 14"Horizontal and 27" Vertical; Match repeat on all chairs. Chair shall meet ANSI/BIFMA X5.2 2017 general purpose officce chair testing guidelines.
8. **Dimensions:** Overall: 22-3/8" to 34-5/8"W x 21" to 23-5/8"D x 47-3/8" to 55-5/8"H
9. **Finishes:** Upholstery: Luum Macrotweed, Color Galena
   Frame, Arms, Base: Black
   Stool Ring: Chrome
   Mesh: Black



SEAT UPHOLSTERY



FRAME AND BASE FINISH



end of order

ORDER DATA SHEETS FOR STORAGE

LOCATION CODES: S1

1. **Location Code:** **S1**
2. **Basis of Design Product:** **Durham Closed Shelving System**
3. **Mezzanine - 201** **6**
4. **Total Quantity:** **6**

5. **Part Description:** Closed Steel Shelving System: 4 shelves 1650 shelf capacity, 12 gauge

6. **Dimensions:** 48"W x 24"D x 96"H$\pm$
7. **Finishes:** Gray - Textured

8. **Freight:** FOB Destination

end of order

ORDER DATA SHEETS FOR SYSTEMS FURNITURE & WORKBENCH

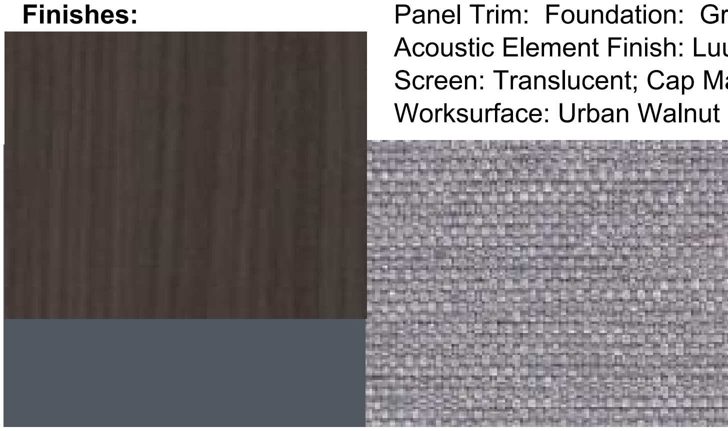
LOCATION CODES: SF1, SF2, SF3, SF4, WB1

SYSTEMS FURNITURE
/ WORKBENCH

1. **Location Code:** SF1
2. **Basis of Design Product:** Teknion - L-Shaped Workstation
3. **Room Name/ Number:** **Quantity:**
   Workstations - 104 **6**
4. **Total Quantity:** **6**
5. Provide a 8'-0" x 9'-0" L-shaped workstation with overhead storage and a sliding door with lock. Provide power and data from a wall connection. Worksurfaces shall be fabricated using balanced plys. Provide the following products:
   (1) Mobile Box/Box/file (BBF) unit keyed alike to station
   (1) Mobile File/file (FF) unit keyed alike to station
   (2) 48"W x 30"D Rectangular worksurfaces provide a grommet in both corners of the worksurface
   (1) 72"W x 30"D (nominal dimensions) Rectangular 3-stage height adjustable C-leg table desk. Provide a grommet at both corners and at center.
   (1) 72"W x 24"D Rectangular worksurfaces provide a grommet in both corners of the worksurface
   (1) Sliding Screen
   (1) Non-powered (NP), finished open frame, segmented panels, 30"W x 66"H
   (1) Non-powered (NP), segmented panels, 24"W x 66"H
   (3) Non-powered (P), segmented panels, 24"W x 66"H
   (3) Non-powered (P), segmented panels, 36"W x 66"H
   (4) Non-powered (P), segmented panels, 48"W x 66"H
   (2) Metal Flipper overhead storage units (OH), 36"W, keyed alike to station
   (4) L- Corner Post, 66"H with metal top cap
   Provide metal bases, all metal top caps and metal end caps for panels. Upholstery shall be 55.8% Polyester, 28.7% Post-Industrial Recycled Polyester and 15.5% Post Consumer Recycled Polyester, weight of 15.7oz per linear yd. Fabric is 66 inches wide and repeat shall be 063 in. vertical and horizontal. ***See Specification Section 12 59 00 for additional information.***

Add open frame panels next submittal

6. **Dimensions:** Overall dimensions: 9'-6" x 8'-6" (Nominal)
7. **Finishes:** Panel Trim: Foundation: Granite Satin
   Acoustic Element Finish: Luum Actuate; Color - Facet; 4073-04
   Screen: Translucent; Cap Match Foundation Color
   Worksurface: Urban Walnut



8. **Freight:** FOB Destination

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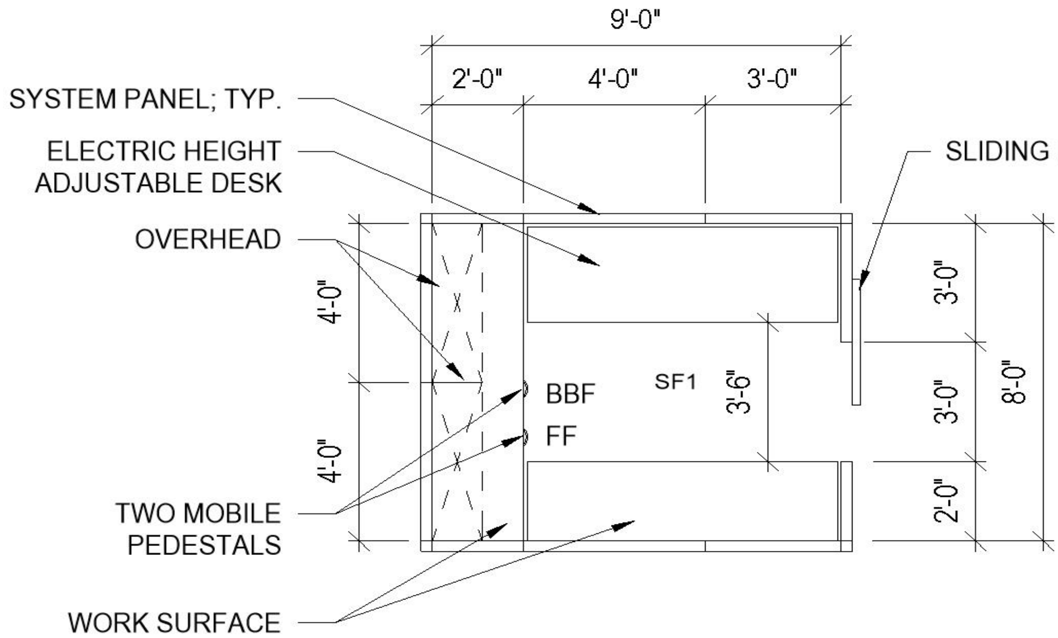
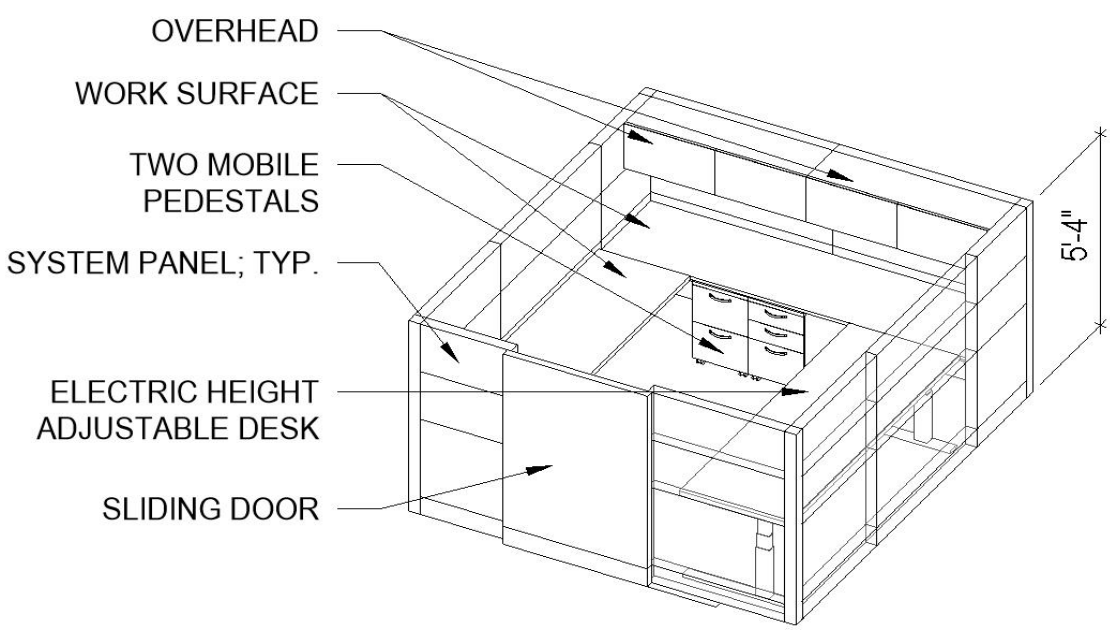
SYSTEMS FURNITURE
/ WORKBENCH

SF1 CONTINUED



PLAN VIEW



3D VIEW

end of order

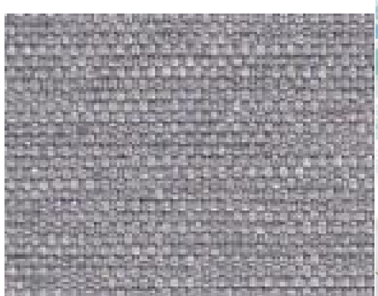
SYSTEMS FURNITURE

1. **Location Code:** SF2 / WORKBENCH
2. **Basis of Design Product:** Teknion - L-Shaped Workstation
3. **Room Name/ Number:** **Quantity:**
   Workstations - 104 **1**
4. **Total Quantity:** **1**
5. Provide a 9'-0" x 12'-0" L-shaped workstation with overhead storage and a sliding door with lock. Provide power and data from a wall connection. Worksurfaces shall be fabricated using balanced plys. Provide the following products:
   (1) Box/box/file (BBF) unit keyed alike to station
   (1) File/file (FF) unit keyed alike to station
   (1) 48"W x 30"D Rectangular worksurfaces provide a grommet in both corners of the worksurface
   (1) 72"W x 30"D (nominal dimensions) Rectangular 3-stage height adjustable C-leg table desk. Provide a grommet at both corners and at center.
   (1) 72"W x 24"D Rectangular worksurfaces provide a grommet in both corners of the worksurface
   (1) 42"W x 24"D Rectangular worksurface provide a grommeta in both corners of the worksurface.
   (1) 66"W x 24"D Rectangular worksurface provide a grommet in both corners of the worksurface
   (1) Non-powered (NP), finished open frame, segmented panel, 30"W x 66"H
   (3) Non-powered (NP), segmented panels, 24"W x 66"H
   (1) Non-powered (NP), segmented panel, 36"W x 66"H
   (2) Non-powered (NP, segmented panels, 42"W x 66"H
   (1) Non-powered (P), segmented panel, 48"W x 66"H
   (1) Non-powered (OF), segmented panel, 24"W x 66"H
   (1) Non-powered (OF), open frame segmented panel, 48"Wx 66"H
   (1) Metal Flipper overhead storage unit (OH), 36"W, keyed alike to station
   (1) Metal Flipper overhead storage unit (OH) 42"W, keyed alike to station
   (3) L- Corner Post, 66"H with metal top cap
   (1) Sliding Privacy Screen
   Provide metal bases, all metal top caps and metal end caps for panels. Upholstery shall be 55.8% Polyester, 28.7% Post-Industrial Recycled Polyester and 15.5% Post Consumer Recycled Polyester, weight of 15.7oz per linear yd. Fabric is 66 inches wide and repeat shall be 063 in. vertical and horizontal. ***See Specification Section 12 59 00 for additional information.***

Add open frame panels next submittal

6. **Dimensions:** Overall Dimensions: 12'-6" x 9'-6" (Nominal)
7. **Finishes:** Panel Trim: Foundation: Granite Satin
   Acoustic Element Finish: Luum Actuate; Color - Facet; 4073-04
   Screen: Translucent; Cap Match Foundation Color
   Worksurface: Urban Walnut



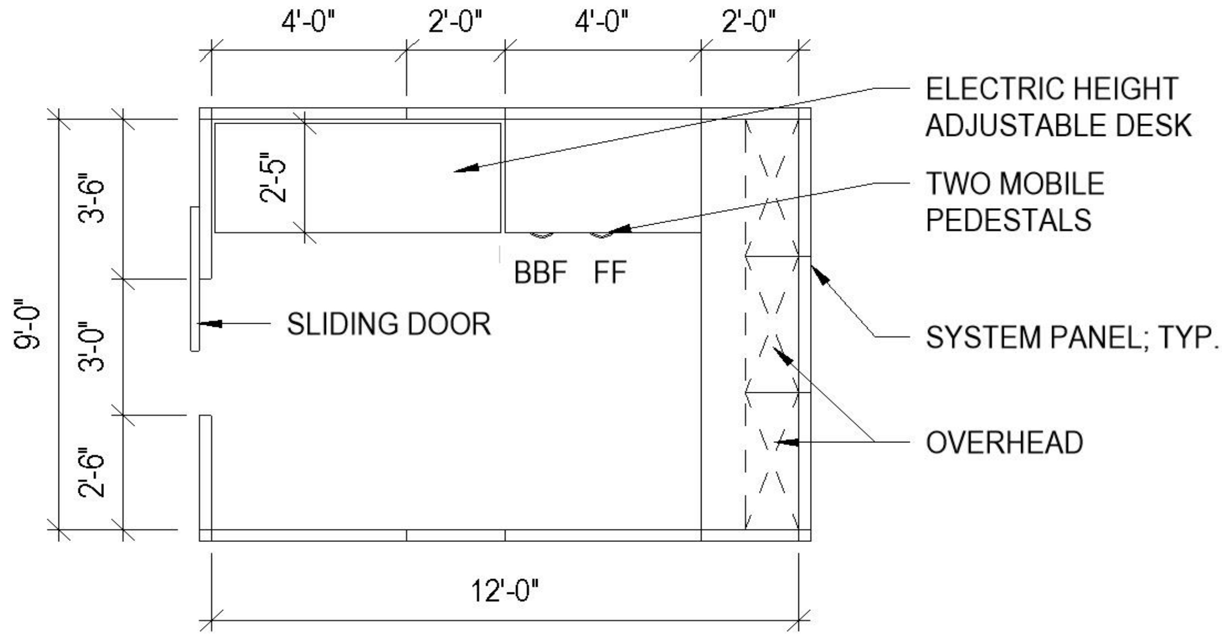


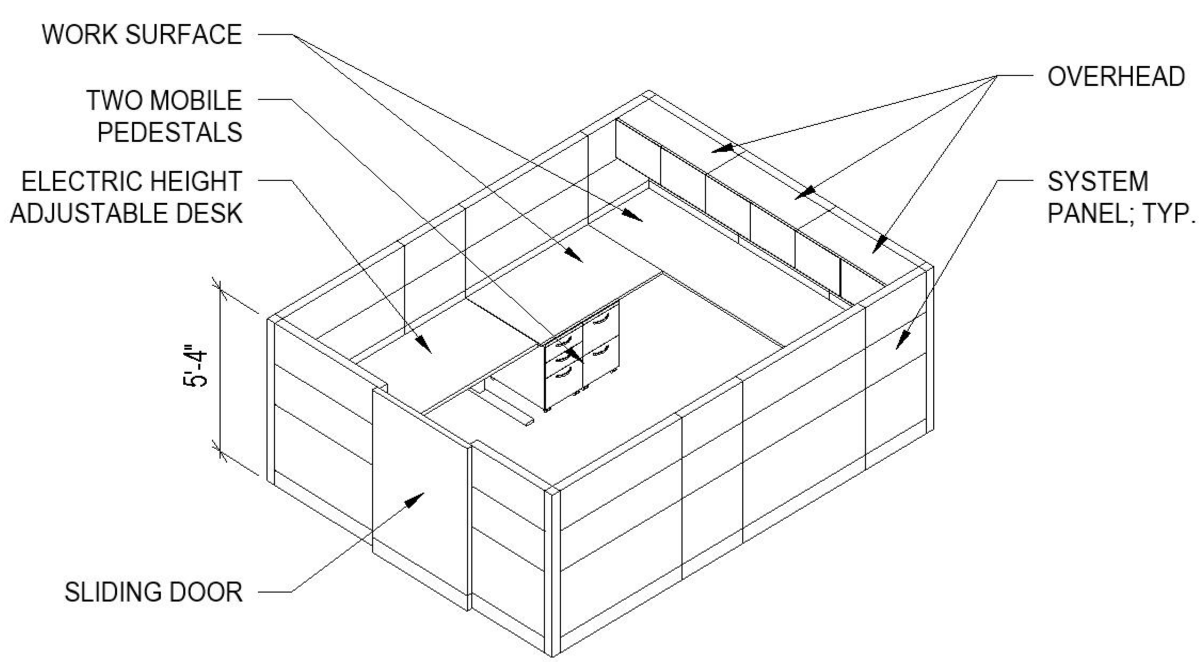

8. **Freight:** FOB Destination

continue next page

SYSTEMS FURNITURE / WORKBENCH

SF2 CONTINUED

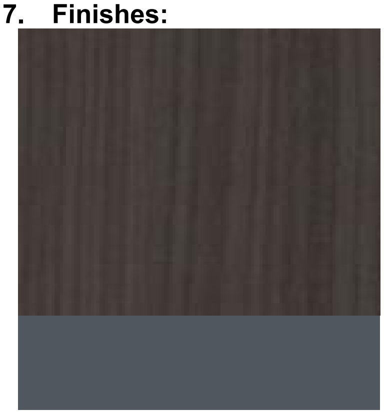
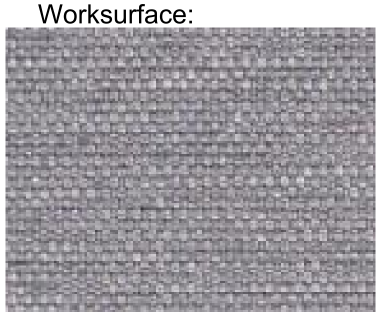




end of order

SYSTEMS FURNITURE

1. **Location Code:** SF3 / WORKBENCH
2. **Basis of Design Product:** Teknion - Leverage L-Shaped Workstation
3. **Room Name/ Number:** **Quantity:**
   Workstations - 104 **1**
4. **Total Quantity:** **1**
5. Provide a 9'-0" x 12'-0" L-shaped workstation with overhead storage and a sliding door with lock. Provide power and data from a wall connection. Worksurfaces shall be fabricated using balanced plys. Provide the following products:
   (1) Box/box/file (BBF) unit keyed alike to station
   (1) File/file (FF) unit keyed alike to station
   (1) 48"W x 24"D Rectangular worksurface provide a grommet in both corners of the worksurface
   (1) 96"W x 24"D Rectangular worksurface, provide a grommet in both corners of worksurface.
   (1) 72"W x 30"D (nominal dimensions) Rectangular 3-stage height adjustable C-leg table desk. Provide a grommet at both corners and at center.
   (1) 72"W x 24"D Rectangular worksurfaces provide a grommet in both corners of the worksurface
   (1) 42"W x 24"D Rectangular worksurface provide a grommeta in both corners of the worksurface.
   (1) 66"W x 24"D Rectangular worksurface provide a grommet in both corners of the worksurface
   (1) Non-powered (NP), finished open frame, segmented panel, 30"W x 66"H
   (2) Non-powered (NP), segmented panels, 24"W x 66"H
   (3) Non-powered (NP), segmented panel, 36"W x 66"H
   (2) Non-powered (NP, segmented panels, 48"W x 66"H
   (1) Non-powered (OF), segmented panel, 24"W x 66"H
   (1) Non-powered (OF), segmented panel, 36"W x 66"H
   (4) Non-powered (OF), open frame segmented panel, 48"Wx 66"H
   (3) Metal Flipper overhead storage unit (OH) 48"W, keyed alike to station
   (3) L- Corner Post, 66"H with metal top cap
   (1) Sliding Privacy Screen
   Provide metal bases, all metal top caps and metal end caps for panels. Upholstery shall be 60% Polyester and 40% Recycled Polyester. Fabric is PFOA/PFOS and Heavy Metal Free. ***See Specification Section 12 59 00.***
6. **Dimensions:** Overall Dimensions: 12-6" x 9'-6" (Nominal)
7. **Finishes:** Panel Trim: Foundation: Granite Satin
   Acoustic Element Finish: Luum Actuate; Color - Facet; 4073-04
   Screen: Translucent; Cap Match Foundation Color
   Worksurface:


8. **Freight:** FOB Destination

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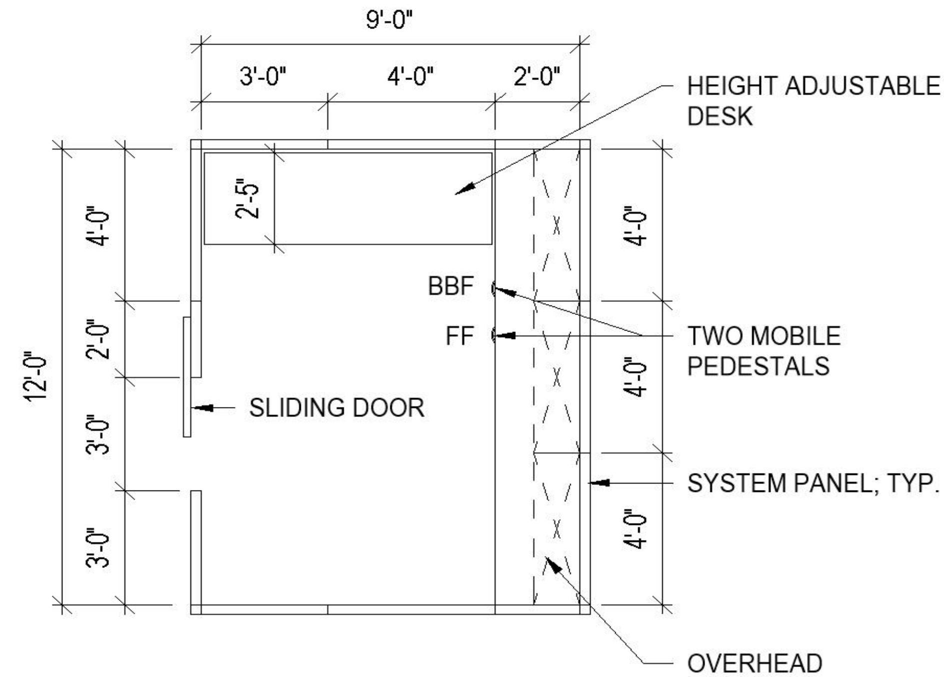
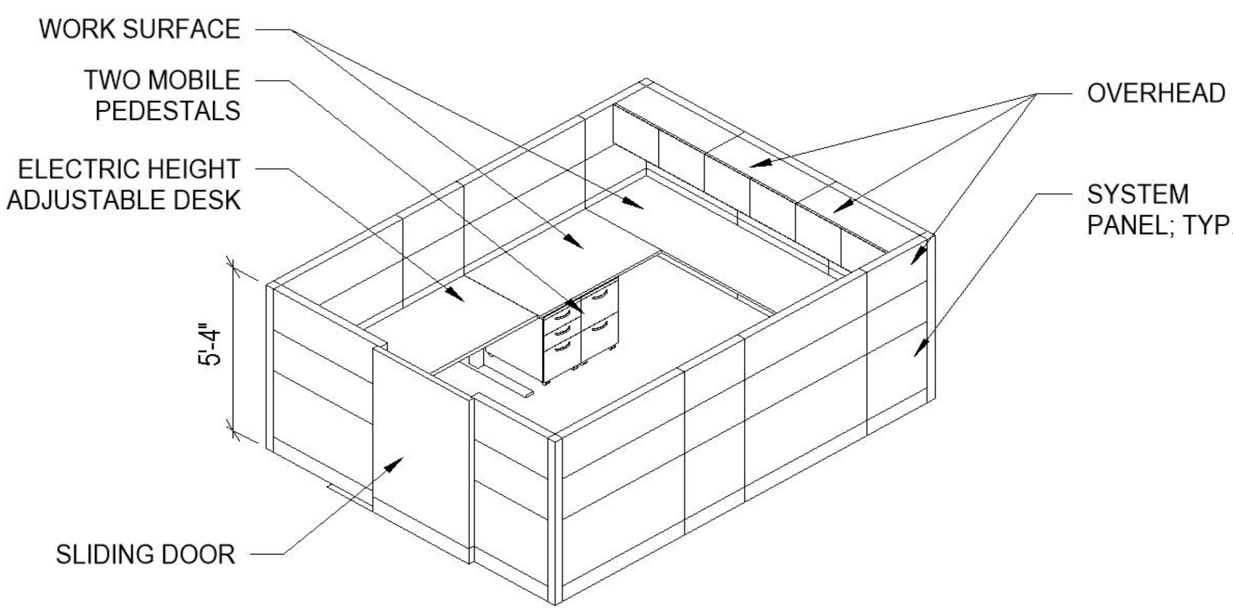
SYSTEMS FURNITURE
/ WORKBENCH

SF3 CONTINUED



PLAN VIEW



3D VIEW

end of order

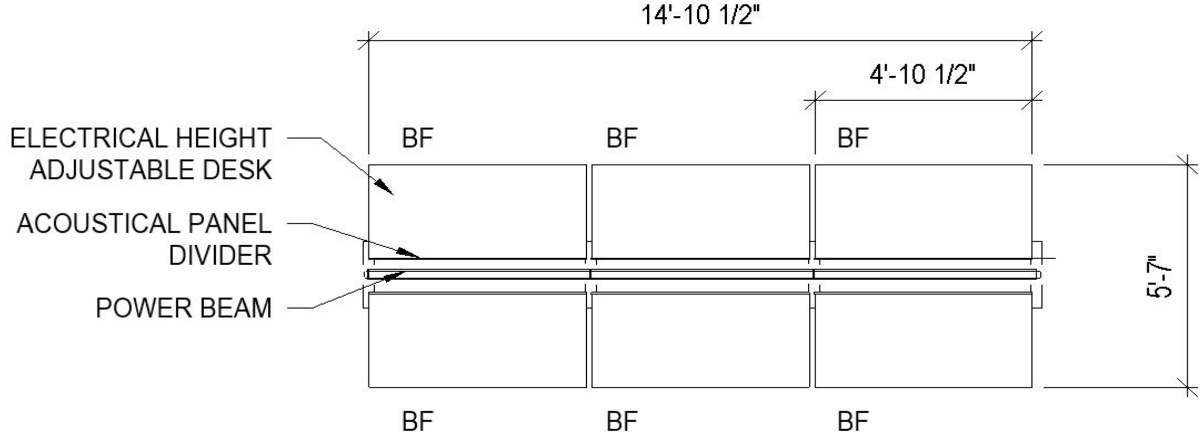
SYSTEMS FURNITURE
/ WORKBENCH

1.	**Location Code:**	**SF4**
2.	**Basis of Design Product:**	**SIT ON IT - 6 Person Height Adjustable Benching Group**
3.	**Room Name/ Number:**	**Quantity:**
	Analysis Room 4 - 118	**1**
	Analysis Room 5 - 119	**1**
4.	**Total Quantity:**	**2**
5.	**Freight:**	**FOB Destination**
6.	**Part Description:**	Provide a double back-to-back adjustable height benching Phase 3 center beam to support 6 total units. All units are to be powered and ganging. Provide all ganging brackets and cover kits, vertical wire Manager, finished metal end panel covers, and ganging jumpers. Column Type: Height Adjustable, 2 Leg, 2 Stage (t-Leg) Edge: Flat Edge Table Size: 29" x 66"W Rectangular Top Grommets: Provide at both left and Right and at Center Provide a programmable controller with 4 presets. Provide Vertical Cable Carrier. Provide 144"L Power Infeed, liquid tight. Provide three duplex receptacles and (1) End Panels Set. Provide Screen Material : Monterrey, Baltic; Size 36" x 72". Provide cable, data and power modules.
7.	**Dimensions:**	Overall Length: 15' x 5'-7"
8.	**Finishes:**	Base Finish: Black Table Top Finish: TL23 Driftwood Cable Manager: Black Grommet Color: Black Screens: Monterrey, Baltic

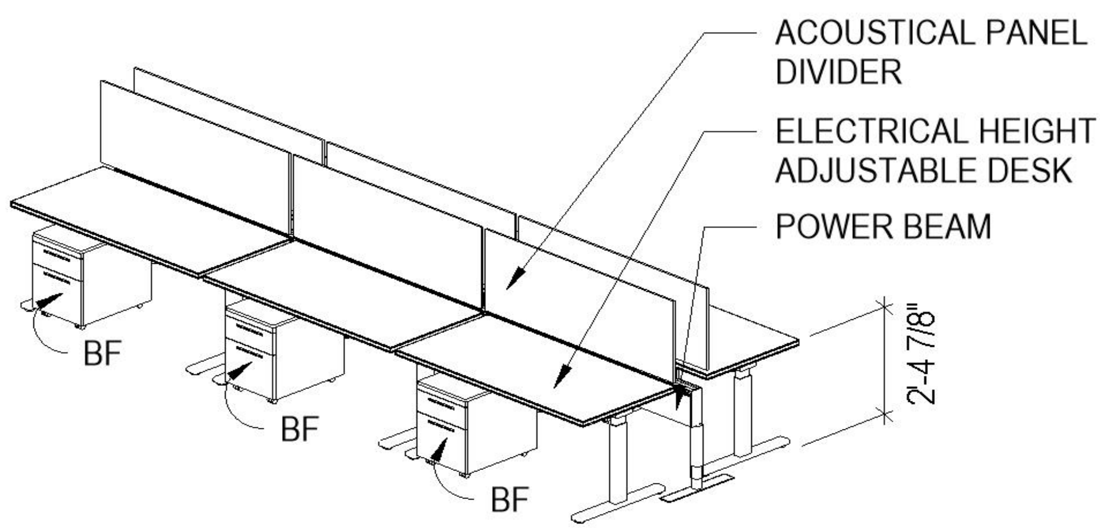
continue next page

SYSTEMS FURNITURE / WORKBENCH

SF4 CONTINUED



PLAN VIEW



3D VIEW

PHOTO VARIES FROM PRODUCT SPECIFIED; PRODUCT REQUIRED FINISHED END PANELS AS PER PHOTO ON LAST PAGE

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SYSTEMS FURNITURE
/ WORKBENCH

SF4 CONTINUED

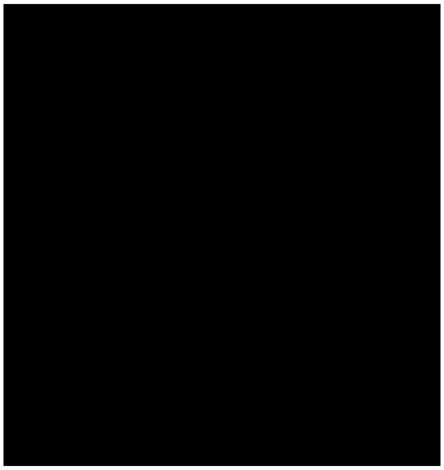
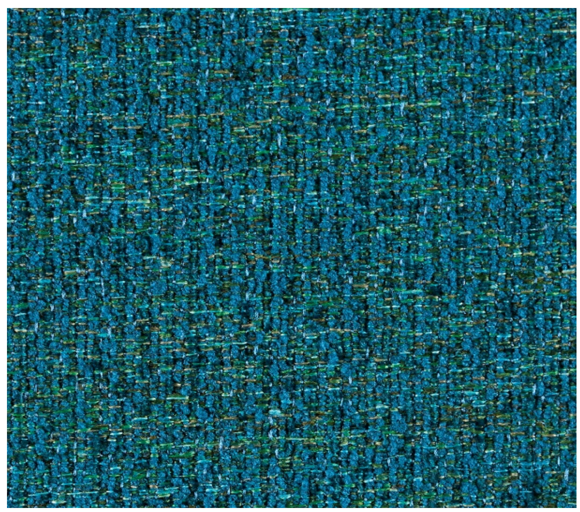


TABLE BASE FINISH

TABLE TOP / SIDE PANEL FINISH - TL23 DRIFTWOOD

RECEPTACLE IMAGE



ACOUSTICAL PANEL FINISH-SIT ON IT - BALTIC

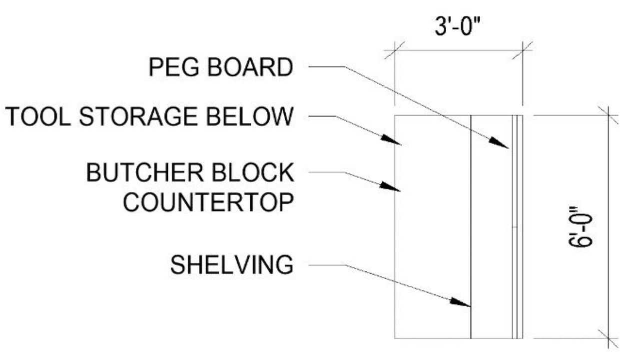
end of order

SYSTEMS FURNITURE
/ WORKBENCH

1. **Location Code:** **WB1**
2. **Basis of Design Product:** **Workbench**
3. **Room Name/ Number:** **Quantity:**
4. **Mezzanine - 201** **1**
5. **Total Quantity:** **1**

6. **Part Description:** Provide 72" x 36" Workbench with leg rest and box drawer and file drawer. Unit shall have 2 - Overhead shelves and an overhead light. Provide 5 duplex receptacles and 12v plug in with 12' cord.

7. **Dimensions:** 72" x 36"
8. **Finishes:** ESD Top
ESD Paint



IAC ESD PAINT

9. **Freight:** FOB Destination
end of order

ORDER DATA SHEETS FOR TABLES AND AUDIOVISUAL SUPPORT FURNISHINGS

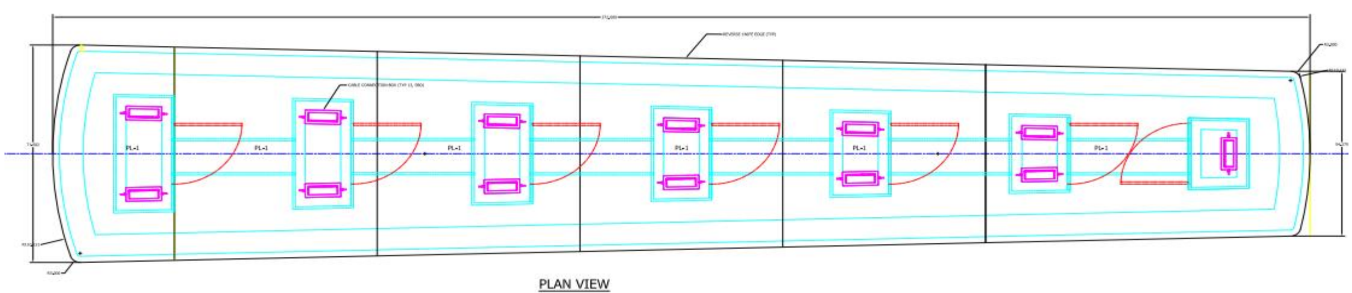
LOCATION CODES: T1, T2, T3, T4, AV1, AV2

TABLES AND AUDIOVISUAL
SUPPORT FURNISHINGS

1. **Location Code:** **T1**
2. **Basis of Design Product:** **Line of Sight Conference Table**
3. **Room Name/ Number:** **Quantity:**
4. **Conference Room - 122** **1**
5. **Total Quantity:** **1**

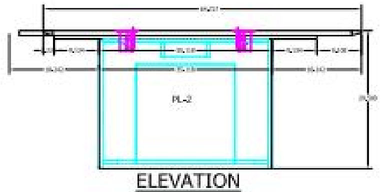
6. **Part Description:** Provide a single Line of Sight table (V-shaped) composed of a table 32'-6"' in length, 54" at the head of the table, and 72" at the end of the table. Each base shall have allow for access to utilities and have a door. The top shall have a 2 sided ...Table is to be fabricated using low-emitting materials including composite wood and adhesives. Composite wood must be from list of EPA Bio-preferred products. Unit shall be fabricated using aluminum substructure.

7. **Dimensions:** Total Size: 5'6"W (narrow end) x 10'-8"W (wide end) x 32'-6"L
8. **Finishes:** Top: Formica 8848-58 Blackened Legno
Base: Formica 8848-58 Blackened Legno

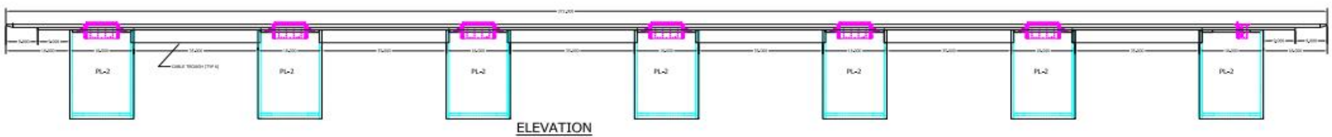


9. **Freight:** FOB Destination
see following page

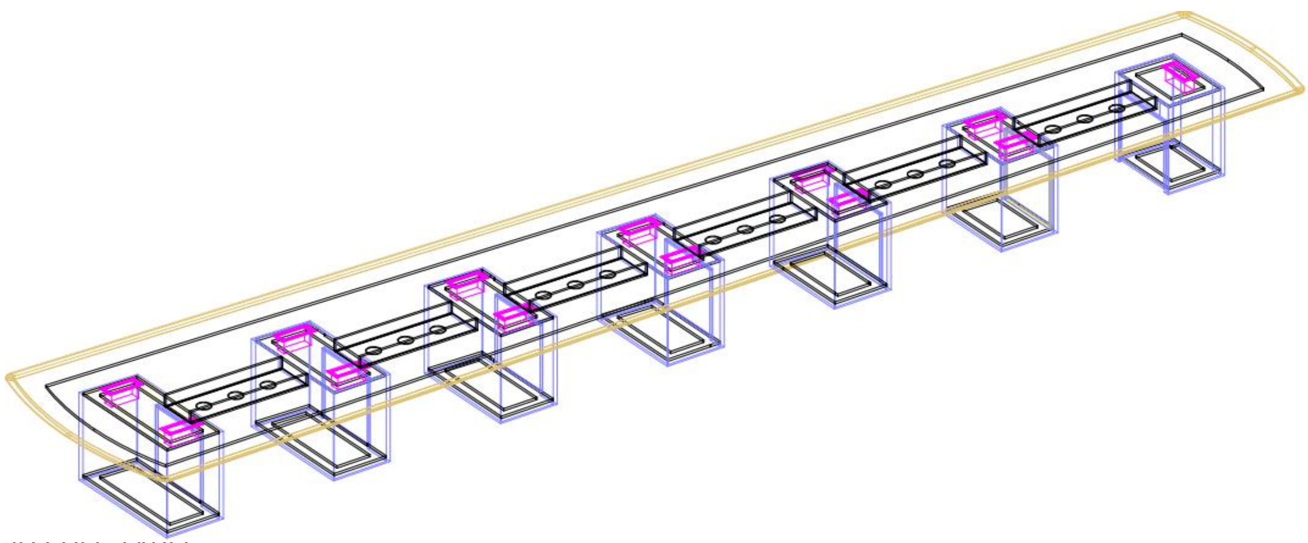
T1 CONTINUED



END ELEVATION



SIDE ELEVATION

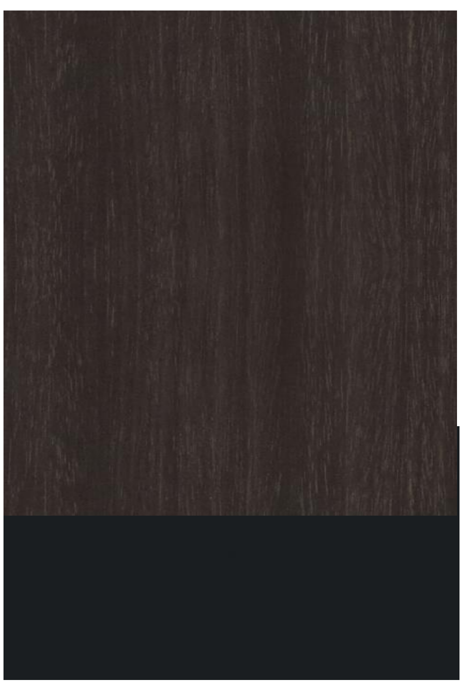


3D FULL TABLE

end of order

TABLES AND AUDIOVISUAL
SUPPORT FURNISHINGS

1. **Location Code:**	**T2**
2. **Basis of Design Product:**	**Nucraft - Fleet - C-Leg Table on Casters with Modesty Panel**
3. **Room Name/ Number:**	**Quantity:**
4. **Conference Room - 122**	**8**
5. **Total Quantity:**	**8**
6. **Freight:**	FOB Destination
7. **Part Description:**	Provide a table with a C-Leg and four locking casters. The vertical section of each leg includes a wire management channel along the inside surface. Legs shall be Edge Mounted to provide the maximum aboutn of leg space. A removable cap hides the cables running from the floor. The modesty panel is inset 1-1/2" from each end of the table, flush with the outer edge of the leg, creating a minimal visual gap between modesty panels in the ganged appllications. Provide a gaangin connector on all tables; See Shee I-102 for layout for ganging. Insure tables are sshipped wiwth the necessary threaded inserts in the uderside of the table to accept the ganging mechanism.
8. **Dimensions:**	72"W x 30"D x 28.5"H
9. **Finishes:**	Top: Formica 8848-58 Blackened Legno Base: A8007 Galaxy



FINISH

end of order

TABLES AND AUDIOVISUAL
SUPPORT FURNISHINGS

1. **Location Code:** **T3**
2. **Basis of Design Product:** **Teknion - Routes Table on Casters**
3. **Room Name/ Number:** **Quantity:**
4. **Breakout Room - 125** **5**
5. **Breakout Room - 126** **5**
6. **Total Quantity:** **10**
7. **Freight:** **FOB Destination**

8. **Part Description:** Provide rectangular high-top work table with casters on all four legs and a foot rail. Top to have a laminate finish with a Baltic Ply Edge.

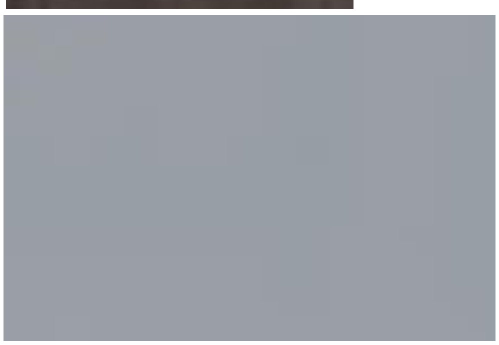
9. **Dimensions:** 36"Diameter x 29" ± H
10. **Finishes:** Top: Urban Walnut
Frame: Ink Blue Satin
Casters: Dark Grey
Edge Trim: Baltic Ply

Frame Finish

end of order

TABLES AND AUDIOVISUAL
SUPPORT FURNISHINGS

1. Location Code:	**T4**
2. Basis of Design Product:	**National - Universal**
3. Room Name/ Number:	**Quantity:**
4. SF2 - Room 104	**1**
5. SF3 - Room 104	**1**
6. Total Quantity:	**2**
7. Freight:	**FOB Destination**
8. Part Description:	Provide 36" diameter table with disc base.
9. Dimensions:	60"W x 30"D x 41"H
10. Finishes:	Top: Plastic Laminate - Urban Walnut Base: Platinum Metallic 501



Base Finish

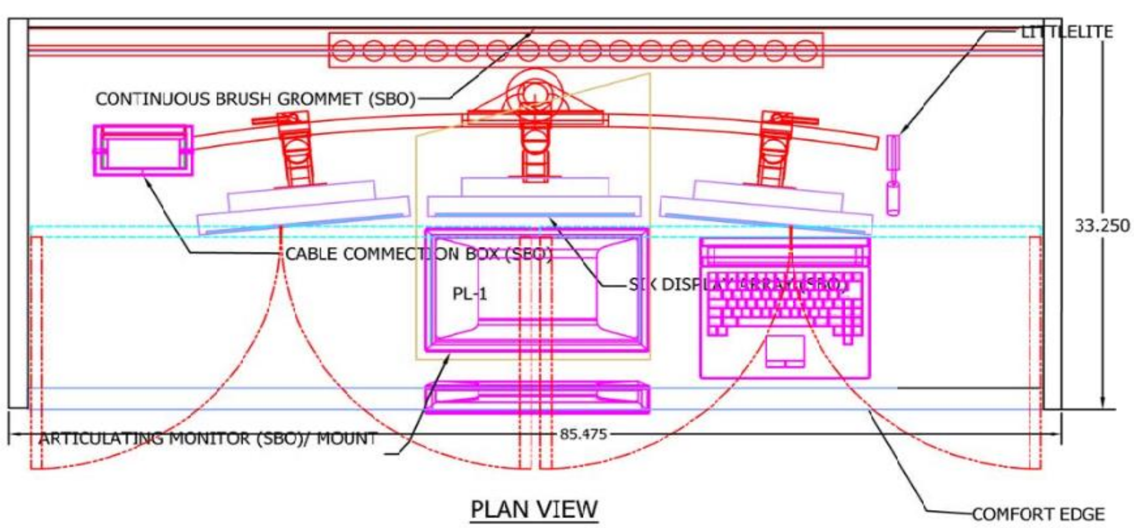
end of order

TABLES AND AUDIOVISUAL
SUPPORT FURNISHINGS

1. **Location Code:** **AV1**
2. **Basis of Design Product:** **AV Cabinet**
3. **Room Name/ Number:** **Quantity:**
4. **Conference Room - 122** **1**
5. **Total Quantity:** **1**
6. **Freight:** **FOB Destination**

7. **Part Description:** AV Cabinet with space 2 operator seats Unit is fabricated using low-emitting materials including composite wood and adhesives. Composite wood must be from list of EPA Bio-preferred products. Unit shall be fabricated using aluminum substructure. Panels are covered with high pressure plastic laminate on face and sides. Inside face is covered with black vertical grade plastic laminate to provide a balanced ply. Audio visual credenza with 6" high fixed shelf and two doors. Provide air slots above on back side of credenza as indicated below to allow for air movement. Provide flush overlay construction with concealed hinges. Doors open on both side of unit. Media backdrop and shelf fabricated from composite wood panels with plastic laminate face. AV racks are to be provided by this vendor.

8. **Dimensions:** 5'-1"W x 2'-6" D
9. **Finishes:** Top and Base: Formica 8848-58 Blackened Legno
Edge: 3mm vinyl edge, Black
Pulls: Top Knobs: Kinney Pull; size; 5 1/16" pull in Flat Black
Back side pulls: Match Haefele Metal Flush pull; Flat Black
Reveal: Black



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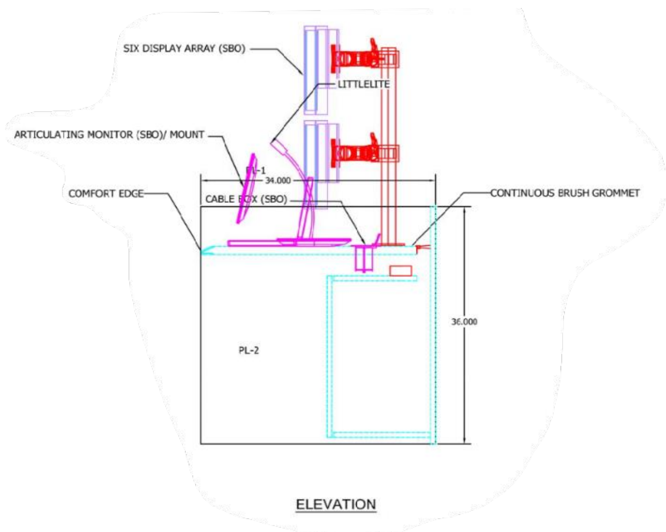
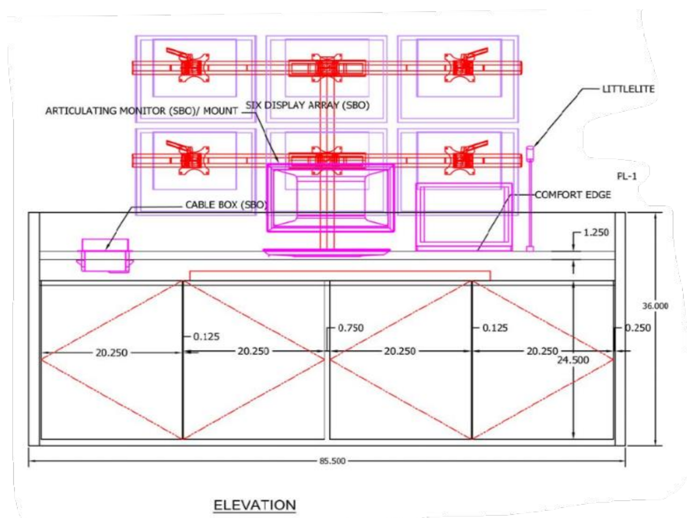
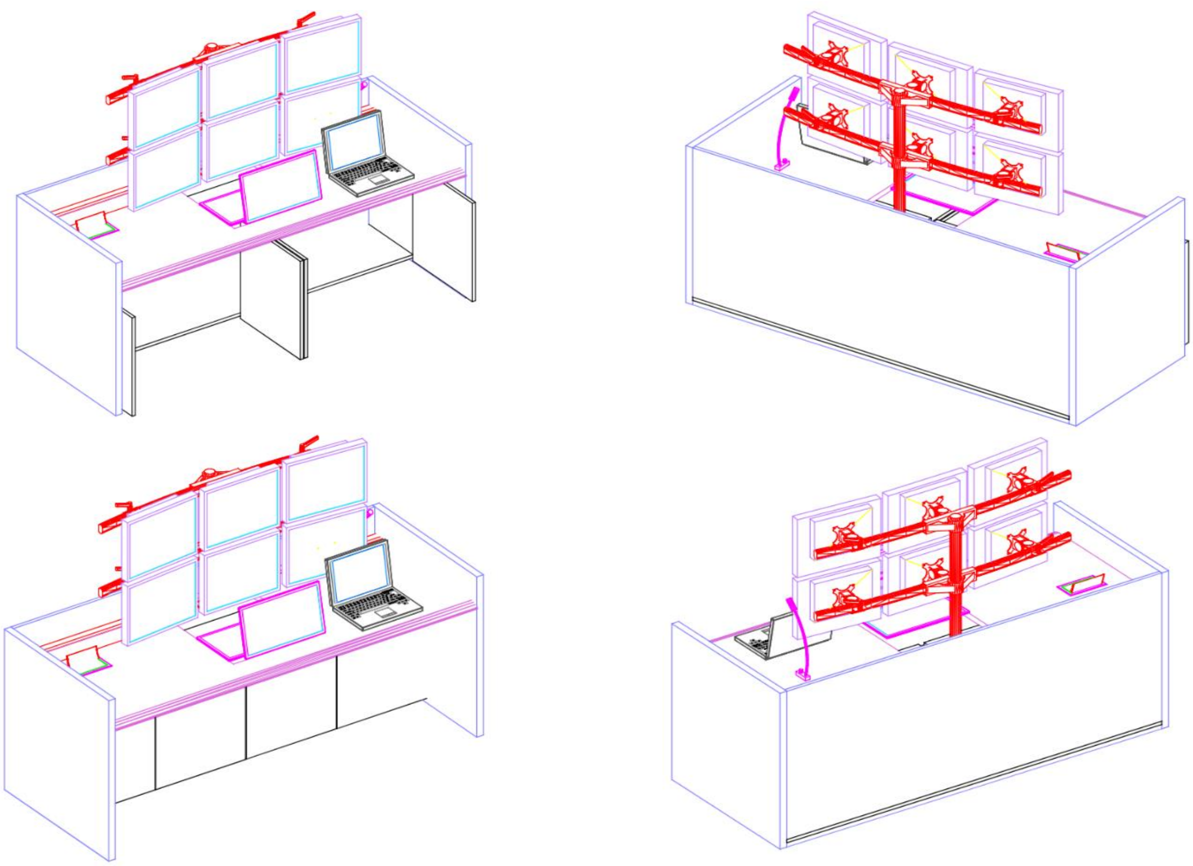
AV1 CONTINUED



END ELEVATION



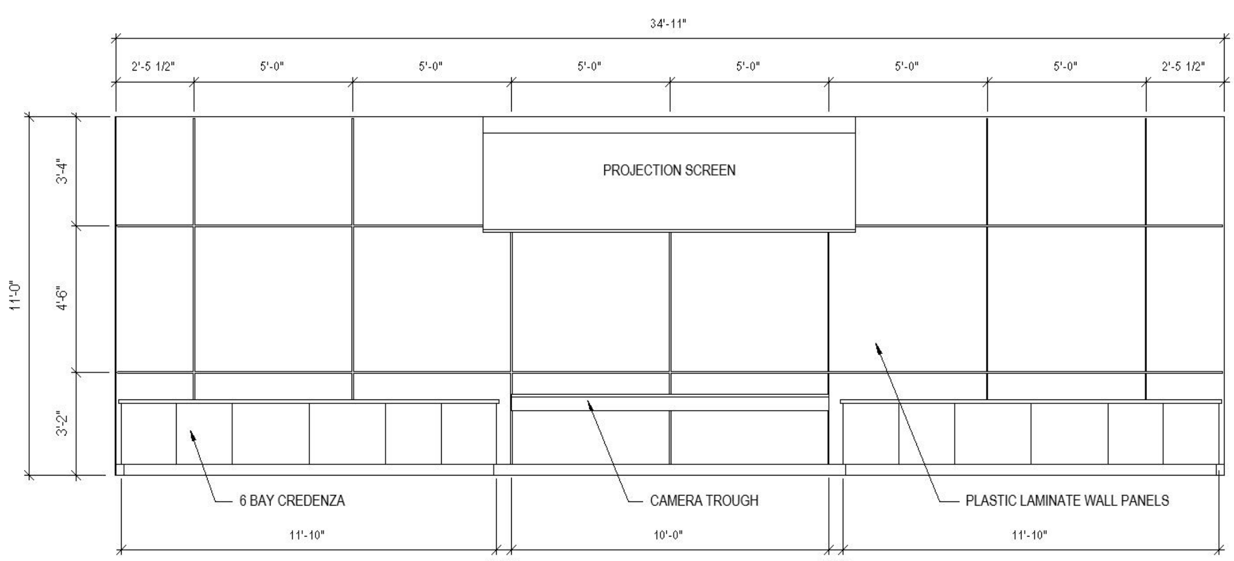


3D VIEWS

end of order

TABLES AND AUDIOVISUAL
SUPPORT FURNISHINGS

1.	**Location Code:**	**AV2**
2.	**Basis of Design Product:**	**Media Wall Panel with Credenzas**
3.	**Room Name/ Number:**	**Quantity:**
4.	**Conference - 122**	**1**
5.	**Total Quantity:**	**1**
6.	**Freight:**	**FOB Destination**
7.	**Part Description:**	Provide a media wall with 2 credenzas and a camera trough. Unit is fabricated using low-emitting materials including composite wood and adhesives. Composite wood must be from list of EPA Bio-preferred products. Panels are covered with high pressure plastic laminate on face and sides. Inside face is covered with black vertical grade plastic laminate to provide a balanced ply. Field dimensions required. Camera and Projection Screen are GFGI.
8.	**Dimensions:**	Top and Base: Formica 8848-58 Blackened Legno Camera Trough: 10'-0"W x 0'-7"D x 0'-6"H Media Wall: Formica 8848-58 Blackened Legno
9.	**Finishes:**	Laminate: Formica 8848-58 Blackened Legno Pulls: Top Knobs: Kinney Pull; size; 5 1/16" pull in Flat Black Back side pulls: Match Haefele Metal Flush pull; Flat Black Reveal: Black



SEE SHEET I-201 FOR ENLARGED IMAGE

end of order

DRAWINGS

BULLOCK TICE ASSOCIATES
909 EAST CERVANTES STREET
PENSACOLA, FLORIDA 32501
850 - 434-5444 PHONE
850 - 432-5208 FAX

FURNITURE SCHEDULE

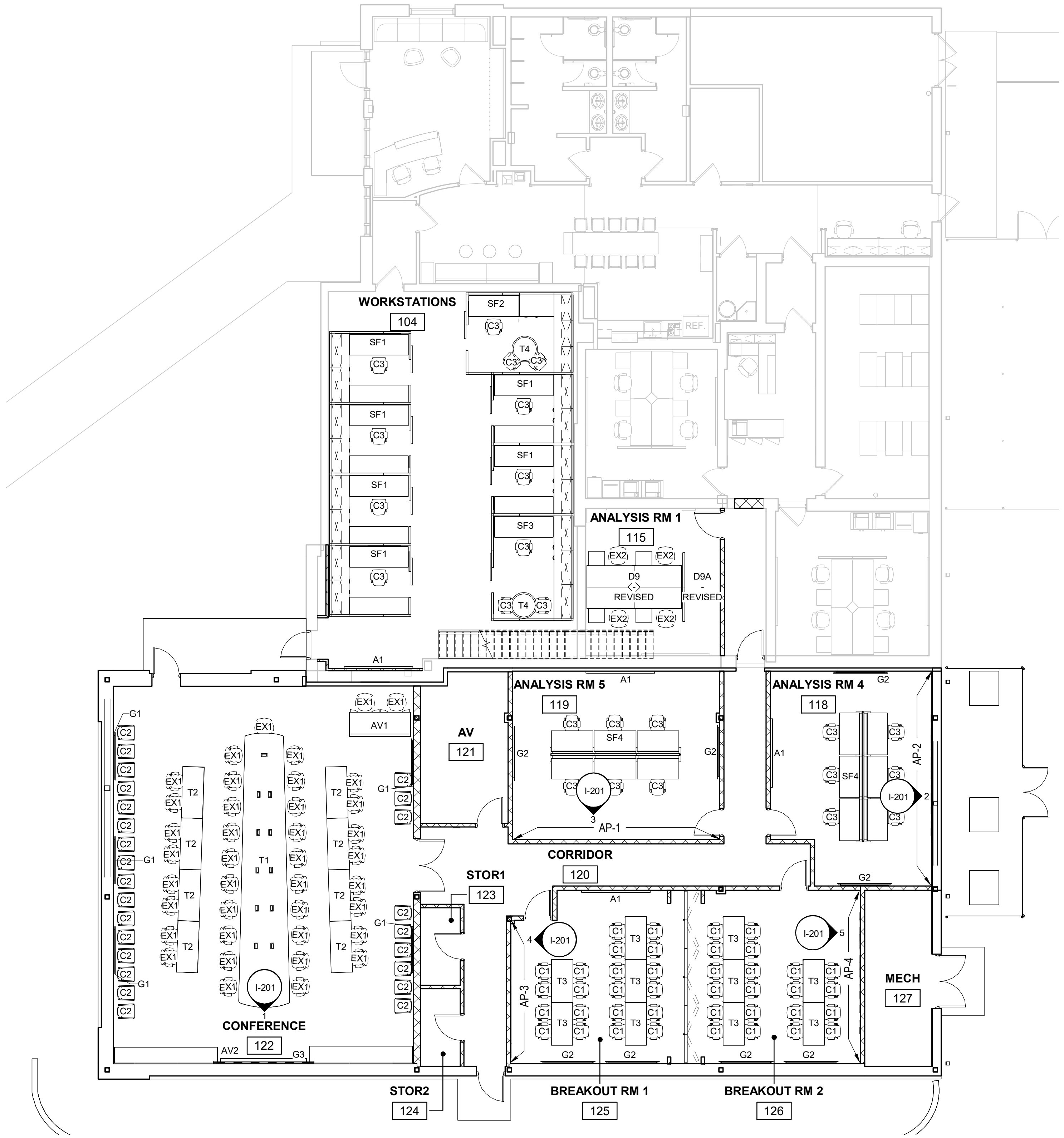
TYPE MARK	DESCRIPTION
A1	MARKER BOARD - 96"W x 48"H
AP1	ACOUSTICAL PANEL
AP2	ACOUSTICAL PANEL
AP3	ACOUSTICAL PANEL
AP4	ACOUSTICAL PANEL
AV1	AUDIO VISUAL CONTROL STATION
AV2	AUDIO VISUAL WALL WITH CREDENZAS
C1	SIT-STAND CHAIR WITH ARMS
C2	GUEST CHAIR
C3	TASK CHAIR
D9 - REVISED	ANALYSIS ROOM DESKING
D9A - REVISED	ANALYSIS ROOM DESKING
EX1	EXISTING CONFERENCE ROOM CHAIR
EX2	EXISTING TASK CHAIR
S1	SHELVING SYSTEM - 4'-0"W X 2'-0"D X 8'-0"H
SF1	U-SHAPED WORKSTATION - 9'-0" X 8'-0"
SF2	L-SHAPED WORKSTATION - 12'-0" X 9'-0"
SF3	L-SHAPED WORKSTATION - 9'-0" X 12'-0"
SF4	6 PERSON HEIGHT ADJUSTABLE BENCHING GROUP
T1	CONFERENCE ROOM TABLE 72" Wx26' Lx 30" H
T2	TABLE - 72"W X 30"D
T3	HIGH-TOP WORK TABLE ON CASTERS - 60"W X 30"D X 41"H
T4	ROUND TABLE - 3' DIAMETER
WB1	WORKBENCH - 72" x 36"

GFGI FURNITURE SCHEDULE

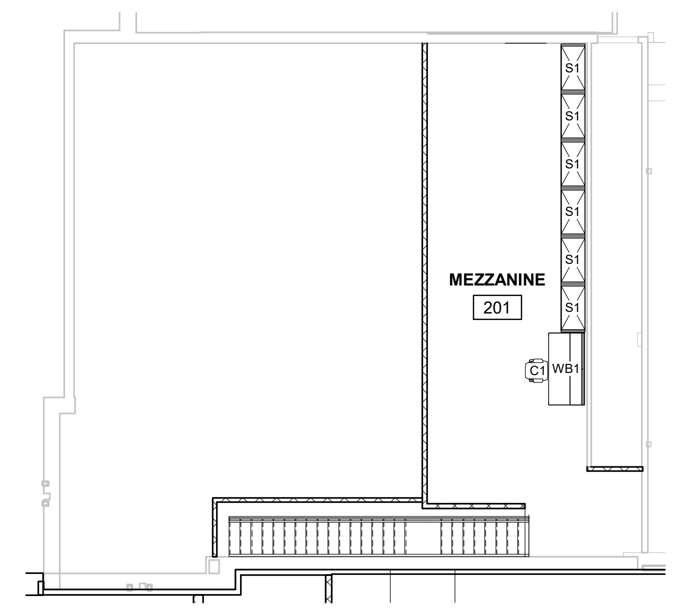
TYPE MARK	DESCRIPTION
G1	FLAT PANEL DISPLAY - 75"
G2	FLAT PANEL DISPLAY - 86"
G3	PROJECTION SCREEN

FURNITURE LEGEND

MARK	DESCRIPTION
A	ACCESSORIES
AV	AUDIOVISUAL EQUIPMENT
C	SEATING
D	DESKING
E	EQUIPMENT
EX	EXISTING FURNITURE ITEM
G	GOV'T FURNISHED / GOV'T INSTALLED (GFGI)
S	STORAGE
SF	SYSTEMS FURNITURE
T	TABLE
WB	WORKBENCH



PLAN NORTH
1 I-102 FURNITURE PLAN - NEW WORK
1/8" = 1'-0"



PLAN NORTH
2 I-102 FURNITURE PLAN - MEZZANINE NEW WORK
1/8" = 1'-0"

0 4' 8' 16'
SCALE: 1/8" = 1'-0"

65% DESIGN SUBMITTAL

BASE CIVIL ENGINEER
EGLIN AIR FORCE BASE, FLORIDA

DRAWN BY K. McMURRAY
PROJ. ENGR. J. SAWYER

TITLE: ADDITION AND RENOVATION B521

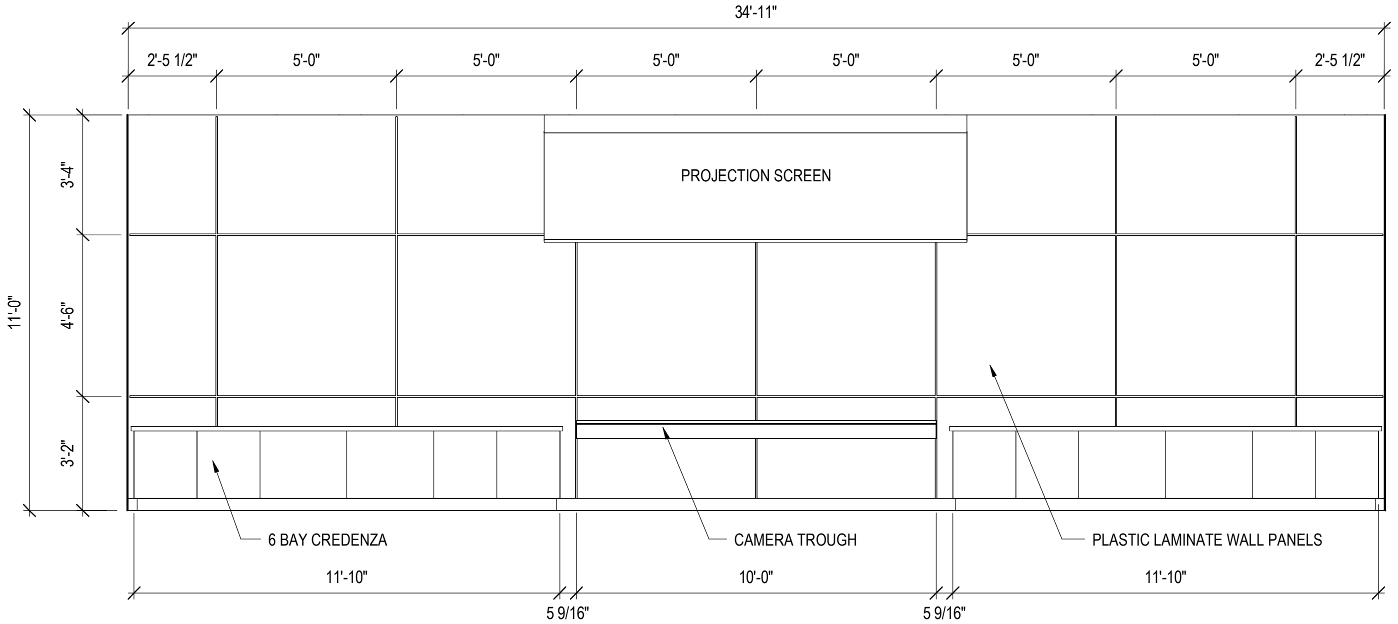
DATE
SIGNATURE

APPROVED FIRE PREVENTION
APPROVED SAFETY REPRESENTATIVE
APPROVED DIR. BASE MED. SERVICE
APPROVED SECURITY FORCES
APPROVED USING AGENCY
APPROVED ASUS
APPROVED COMMUNICATIONS
APPROVED CHELCO
APPROVED OPERATIONS ENGINEERING
APPROVED 96/CEG/CEN
APPROVED ENVIRONMENTAL
APPROVED DEPUTY BASE CIVIL ENGINEER

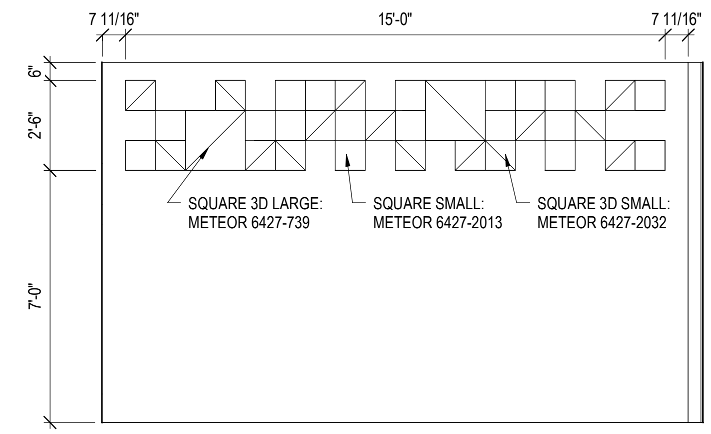
CONTENTS: FURNITURE PLAN

DATE: 13 MARCH 2024
SCALE: AS SHOWN

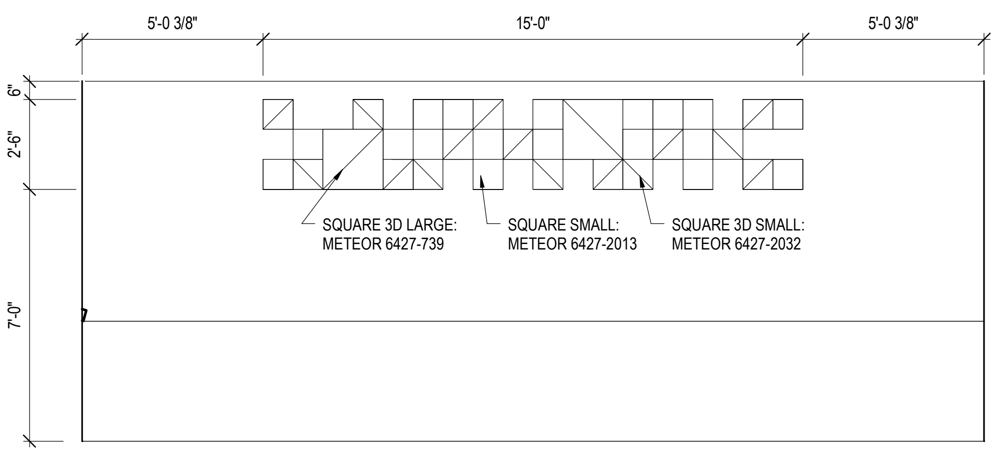
INDEX NO. I-102
SPEC. NO. 23AH
PROJ. NO. FTFA 23-MM06
DRAWING NO.
FILE NO.
SHEET OF



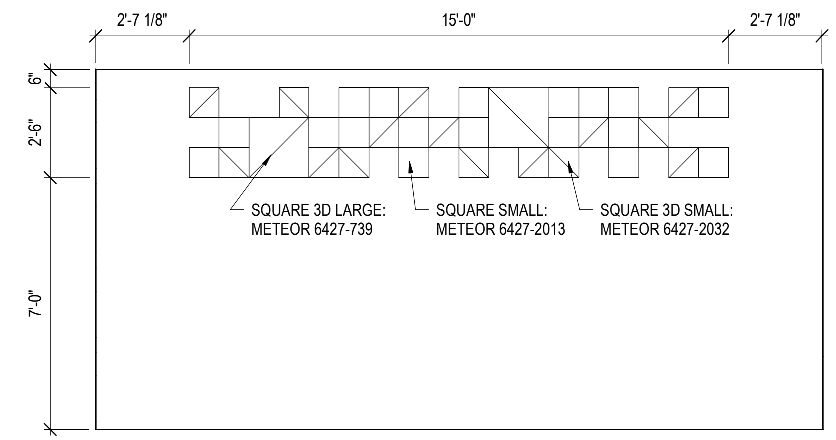
1 I-201 CONFERENCE ROOM 122 AV WALL ELEVATION
3/8" = 1'-0"



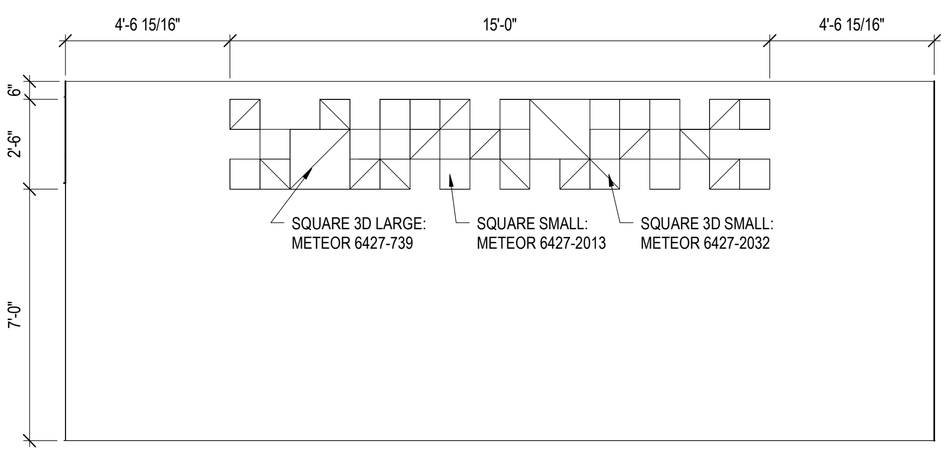
4 I-201 ACOUSTICAL PANEL ELEVATION - ROOM 125
3/8" = 1'-0"



2 I-201 ACOUSTICAL PANEL ELEVATION - ROOM 118
3/8" = 1'-0"



5 I-201 ACOUSTICAL PANEL ELEVATION - ROOM 126
3/8" = 1'-0"



3 I-201 ACOUSTICAL PANEL ELEVATION - ROOM 119
3/8" = 1'-0"

0 1'-4" 2'-8" 5'-4"
SCALE: 3/8" = 1'-0"

BASE CIVIL ENGINEER
EGLIN AIR FORCE BASE, FLORIDA

DATE	DRAWN BY K. McMURRAY	TITLE ADDITION AND RENOVATION B521
SIGNATURE	PROJ. ENGR. J. SAWYER	
	APPROVED FIRE PREVENTION	
	APPROVED SAFETY REPRESENTATIVE	
	APPROVED DIR. BASE MED. SERVICE	
APPROVED SECURITY FORCES	APPROVED USING AGENCY	CONTENTS INTERIOR ELEVATIONS
APPROVED ASUS	APPROVED COMMUNICATIONS	
APPROVED CHELCO	APPROVED OPERATIONS ENGINEERING	APPROVED 96/CEG/CEN
INDEX NO. I-201	APPROVED ENVIRONMENTAL	APPROVED DEPUTY BASE CIVIL ENGINEER
	SPEC. NO. 23AH	PROJ. NO. FTFA 23-MM06

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DATE 13 MARCH 2024
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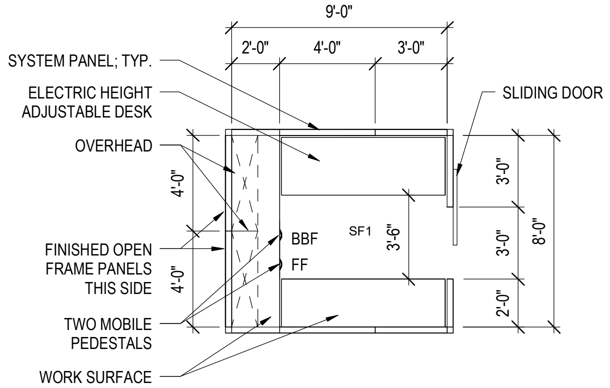
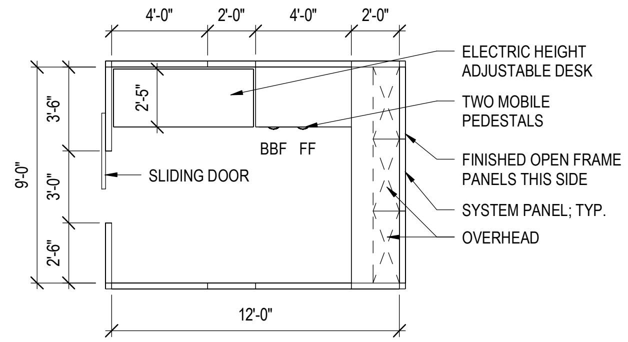
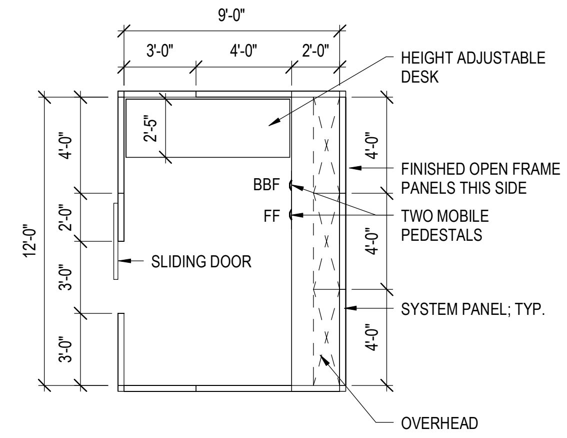


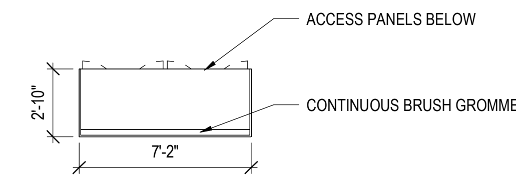
1 I-401 SF1- PLAN VIEW
1/4" = 1'-0"



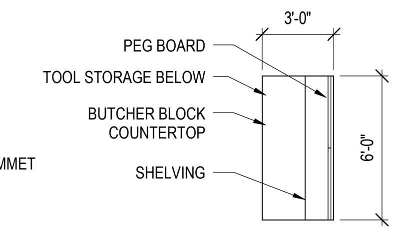
3 I-401 SF2- PLAN VIEW
1/4" = 1'-0"



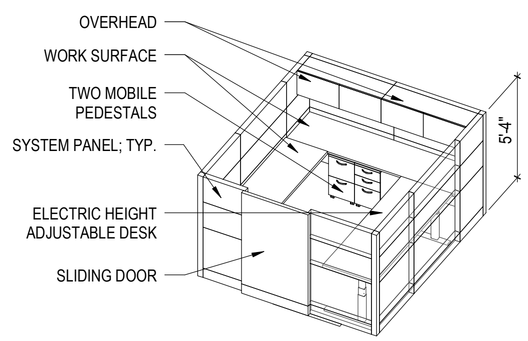
5 I-401 SF3- PLAN VIEW
1/4" = 1'-0"



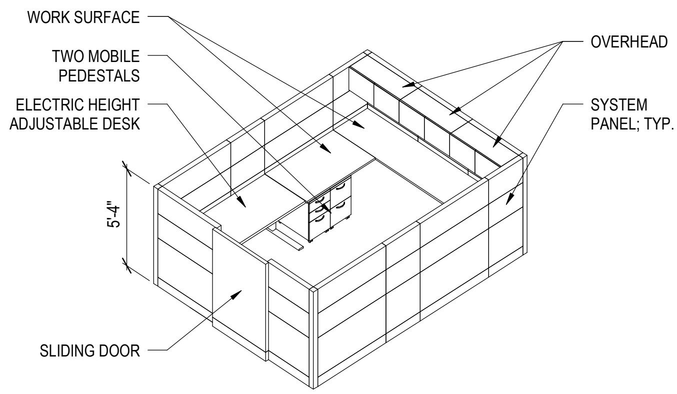
7 I-401 AV1- PLAN VIEW
1/4" = 1'-0"



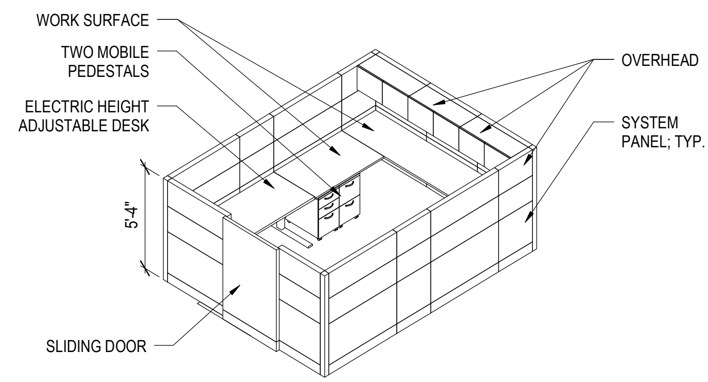
9 I-401 WB-1 -PLAN VIEW
1/4" = 1'-0"



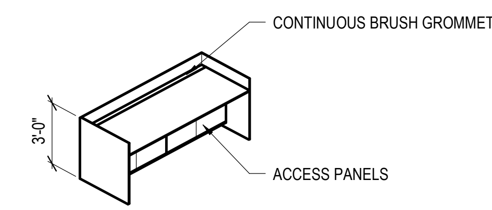
2 I-401 SF1- 3D VIEW



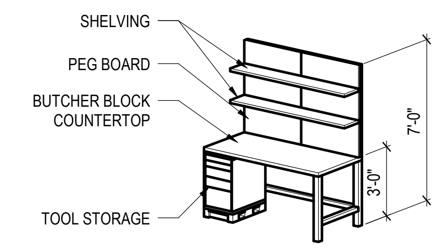
4 I-401 SF2- 3D VIEW



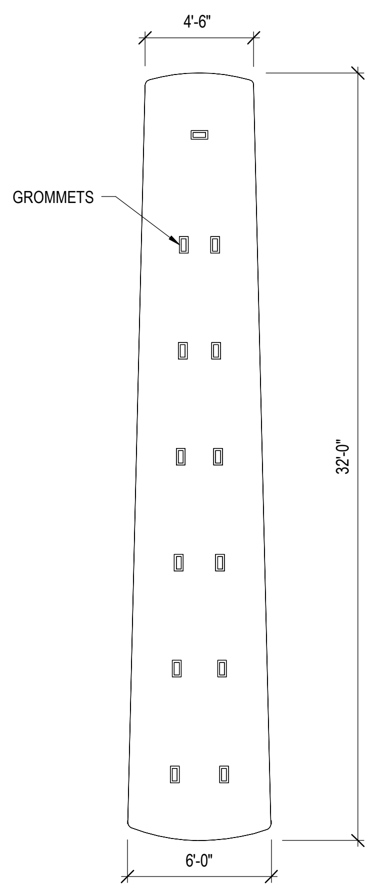
6 I-401 SF3- 3D VIEW



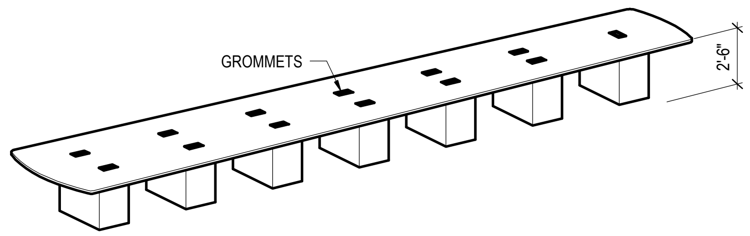
8 I-401 AV1- 3D VIEW



10 I-401 WB-1 3D VIEW



11 I-401 T1- PLAN VIEW
1/4" = 1'-0"



12 I-401 T1- 3D VIEW

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BASE CIVIL ENGINEER
EGLIN AIR FORCE BASE, FLORIDA

DATE	DRAWN BY K. McMURRAY	TITLE ADDITION AND RENOVATION B521
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	APPROVED DIR. BASE MED. SERVICE	
APPROVED SECURITY FORCES	APPROVED USING AGENCY	CONTENTS FURNITURE TYPICALS
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INDEX NO. I-401	APPROVED ENVIRONMENTAL	APPROVED DEPUTY BASE CIVIL ENGINEER
	SPEC. NO. 23AH	PROJ. NO. FTFA 23-MM06

DATE	13 MARCH 2024
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SHEET	OF

FINISH BOARDS

BULLOCK TICE ASSOCIATES
909 EAST CERVANTES STREET
PENSACOLA, FLORIDA 32501
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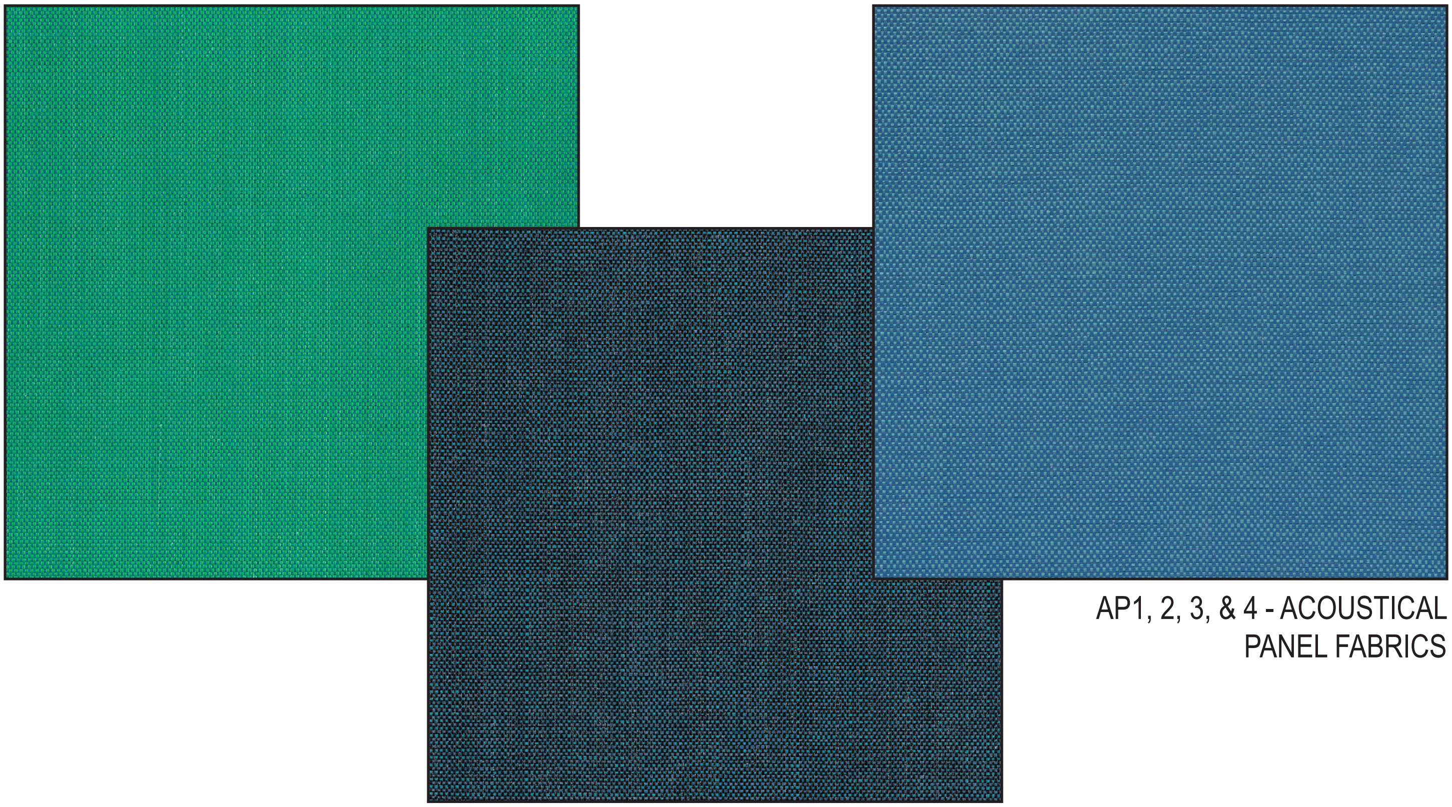
850 - 432-5208 FAX

ADDITION AND RENOVATION B521

FURNITURE, FIXTURES, & EQUIPMENT FINISH BOARD



AP1, 2, 3, & 4 - ACOUSTICAL PANEL FABRICS

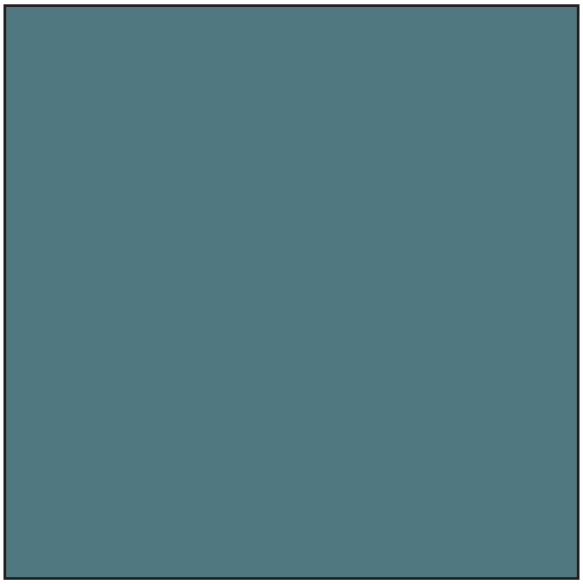
SF1, SF2, SF3 - PANEL FABRIC & TRIM

SF4 - WORKSURFACE, PANEL FABRIC, & BASE

BTA — A GHC COMPANY

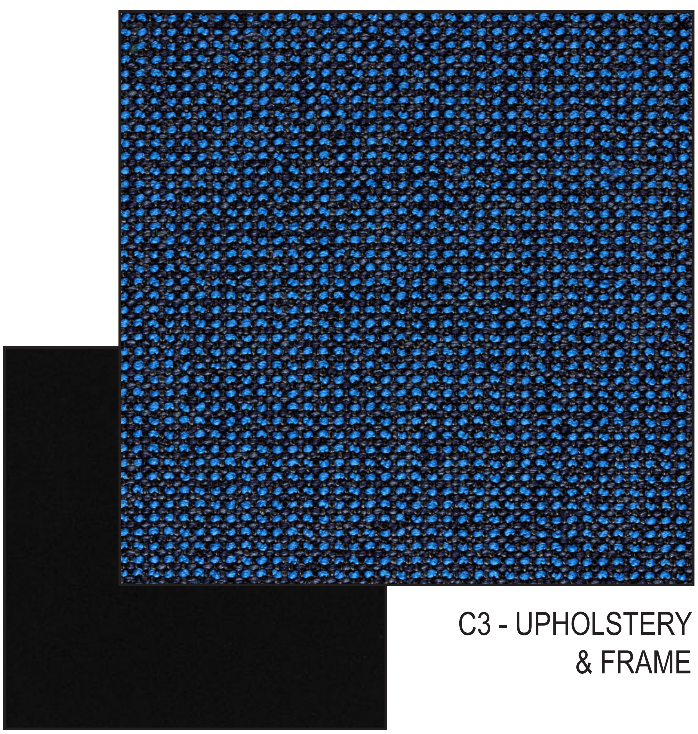
ADDITION AND RENOVATION B521

FURNITURE, FIXTURES, & EQUIPMENT FINISH BOARD



WB1 - ESD PAINT

C1 - UPHOLSTERY
& SHELL



C3 - UPHOLSTERY
& FRAME

C2 - UPHOLSTERY
& FRAME

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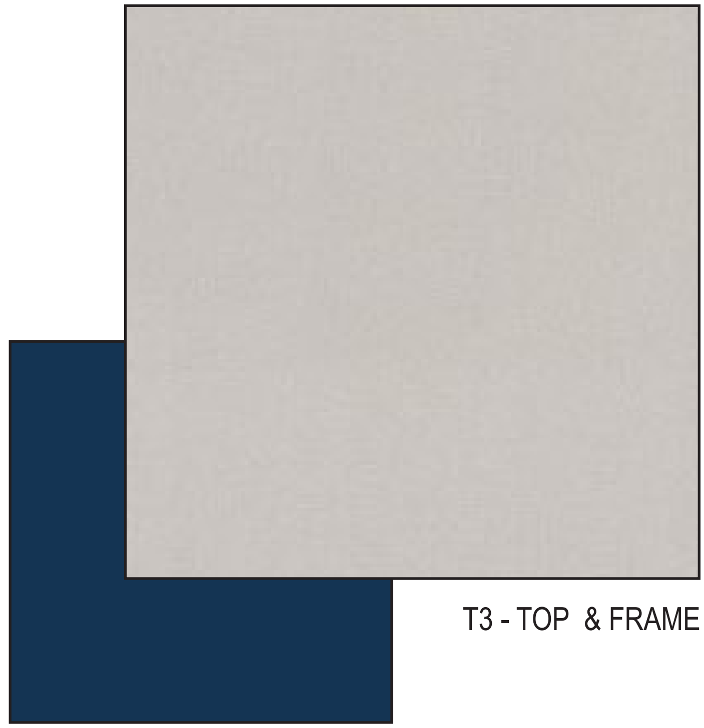
A GHC COMPANY

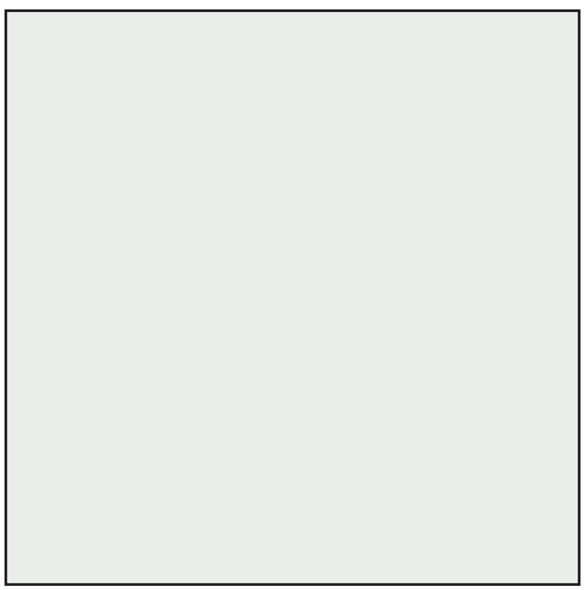
ADDITION AND RENOVATION B521

FURNITURE, FIXTURES, & EQUIPMENT FINISH BOARD

T1, T2, AV1, & AV2 - LAMINATE FINISH



T3 - TOP & FRAME



A1 - GLASS MAGNETIC MARKERBOARD

A GHC COMPANY

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SECTION II – STRUCTURAL INTERIOR DESIGN (SID) 65% DESIGN SUBMITTAL

DESIGN ANALYSIS

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ADDITION AND RENOVATION B521
EGLIN AIR FORCE BASE, FLORIDA

Chapter 6 – Structural Interior Design Requirements (SID)

A. Design Criteria

The following is a list of DoD, and Eglin AFB specific criteria that shall be utilized for the design of this facility. Refer to other chapters for additional criteria specific to each design element.

1. Engineering Design Manual Eglin AFB, Florida, February 2019 with referenced:
   a. Eglin AFB Architectural Compatibility Plan – 2023
   b. 96th Communications Squadron Cyber Infrastructure Design Guide 10 April 2019
   c. CHELCO Design and Construction Standards, December 1, 2008
   d. American States Utility Services, Inc. (ASUS) Standard Details Water and Sewer
2. UFC 1-200-01 General Building Design, September 1, 2022
3. UFC 1-200-02 High Performance Sustainable Building Requirements, 1 Dec. 2020 Change 02, 01 June 2022.
4. UFC 3-120-10 Interior Design, with Change 2, June 15, 2021.
5. UFC 3-600-01 Fire Protection Engineering for Facilities, 8 August 2016, Change 6, 6 May 2021
6. UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings, 12 Dec. 2018, Change 2, 30 July 2022
7. UFC 4-021-01 Mass Notification System, 9 April 2008, Change 1, 1 Jan. 2010
8. International Building Code 2021
9. NFPA 101 2021
10. ABA Accessibility Guidelines, (2015)
11. Florida Building Code (2020) & Miami / Dade County Hurricane Standards
12. USGBC LEED Building Design and Construction (BD&C) rating systems, V4.1
13. EPAct2005 - Energy Policy Act Of 2005
14. EISA 2007 - Energy Independence Security Act Of 2007

B. Design Statement

The renovation and addition project includes a single-story, 4,500 sq ft. addition, and renovation of the existing auditorium space to better meet the users' needs. AFRL personnel will operate the facility, which will be primarily used for virtual wargaming. The project replaces the auditorium space with space for nine workstations and a large storage mezzanine. Two of the workstations will be larger with collaboration space. The Mezzanine will have a storage area with one workbench and three shelving units to house large pelican cases.

The new addition is a secure area and will be accessed using the existing man-trap to the existing secure area. One of the existing analysis rooms will be reduced in size to allow access to the new addition. The existing secure space is a four-sided shielded space. (walls only). The new addition will be a six-sided RF-shielded space with a shielded door between this space and the existing secure space. Both spaces are six-sided secure spaces. Refer to the project overview for the security level requirements of these spaces.

The new addition includes a new 60-person conference room allowing collaboration and interaction with a higher security level, two breakout spaces with an STC-rated operable partition separating them, two new analysis rooms, an AV storage room, and two small storage rooms. A mechanical room is adjacent (outside of the secure perimeter).

C. Structural Interior Design Statement

Our plan is to use the same colors and finishes as the existing facility, with the exception of the conference room. We plan to enhance the conference room's professional appearance through wood and acoustical panels. Both materials contribute to a cohesive but functional room. The wall panels will be used strategically to control sound reflections. Pendant lighting augments the overall appearance.

D. Individual Room Finish Requirements

This chapter is intended to provide specific functional finish requirements by room. Materials are listed to provide a basis of design for cost estimating purposes.

1. **Workstations (formerly the Auditorium)** – This area has most of the demo work consisting of tear-out of the stage, risers, lectern, and tech workbench. The primary flooring used in this area is modular carpet tile. The original product has been discontinued however, we have found a product with similar colorations and will specify that as it will match well at the corridors. The wall base shall be a thermoplastic rubber 4" cove base. The walls will be painted with an egg-shell finish paint. The ceiling will be a high NRC value acoustical tile. The tile will also have a high recycled content to contribute to GBCI points.

2. **Secure Corridor 112A and 120** – The finish materials will be modular carpet tile with the layout closely matching the existing. The wall base shall be a thermoplastic 4" cove base. The walls will be painted with an egg-shell finish. Only a portion of Secure Corridor 112A will require rework. The intent will be to match the existing ceiling tile. First-floor ceilings will be high NRC value acoustical tile. The tile will also have a high recycled content to contribute to GBCI points. Secure Corridor 120 is the new exit access corridor for the Analysis Rooms and the Breakout Rms. It will have the same finishes as the existing corridor.

3. **Analysis Rm 1 113, Analysis Rm 4 118, and Analysis Rm 5 119 –** Analysis Rm 1 will have modular carpet tile closely matching the existing and will have a high NRC value acoustical ceiling tile. The tile will have a high recycled content to contribute to GBCI points. Its existing furnishings will be reworked, and the existing classified printers, safe, and shredder will be removed. Analysis Rms 4 and 5 shall use 6-position height adjustable workstations like those shown at the meeting. These rooms will have acoustical panels that are part of the FF&E. These rooms shall have classified printers, (1) safe, and (1) shredder each.

4. **Breakout Rooms 125 and 126** - Breakout Rooms will have modular carpet tile and thermoset rubber base, 10' ceilings, painted walls with egg-shell finish, and acoustical ceiling tile with a high NRC value. The tile will have a high recycled content to contribute to GBCI points. Surrounding walls will go to the deck.

5. **Conference Room –** Conference Room 122 features a multi-level gypsum board ceiling with an inset of 48" square high NRC Ceiling tile shall have a high recycled content with a 9/16" square edge tegular reveal. The presentation wall shall have plastic laminate wood finish panels with metal reglets. The wood finish will match the line-of-sight table.

6. **AV Room 121 –** Walls shall be painted egg-shell finish, ceiling shall be acoustical ceiling tile, flooring is modular carpet tile finished with thermoplastic rubber base.

7. **Storage Room** – Walls shall be painted egg-shell finish, ceiling shall be acoustical ceiling tile, flooring is modular carpet tile finished with thermoplastic rubber base.

8. **Mechanical/Electrical** – These spaces will have sealed concrete floors, painted walls, and open exposed ceilings. Walls will get two coats of block filler and two coats of semi-gloss paint. The exposed ceiling shall get a coat of semi-gloss paint. A Thermoplastic rubber cove base will be used on walls finished with gypsum board.

DRAWINGS

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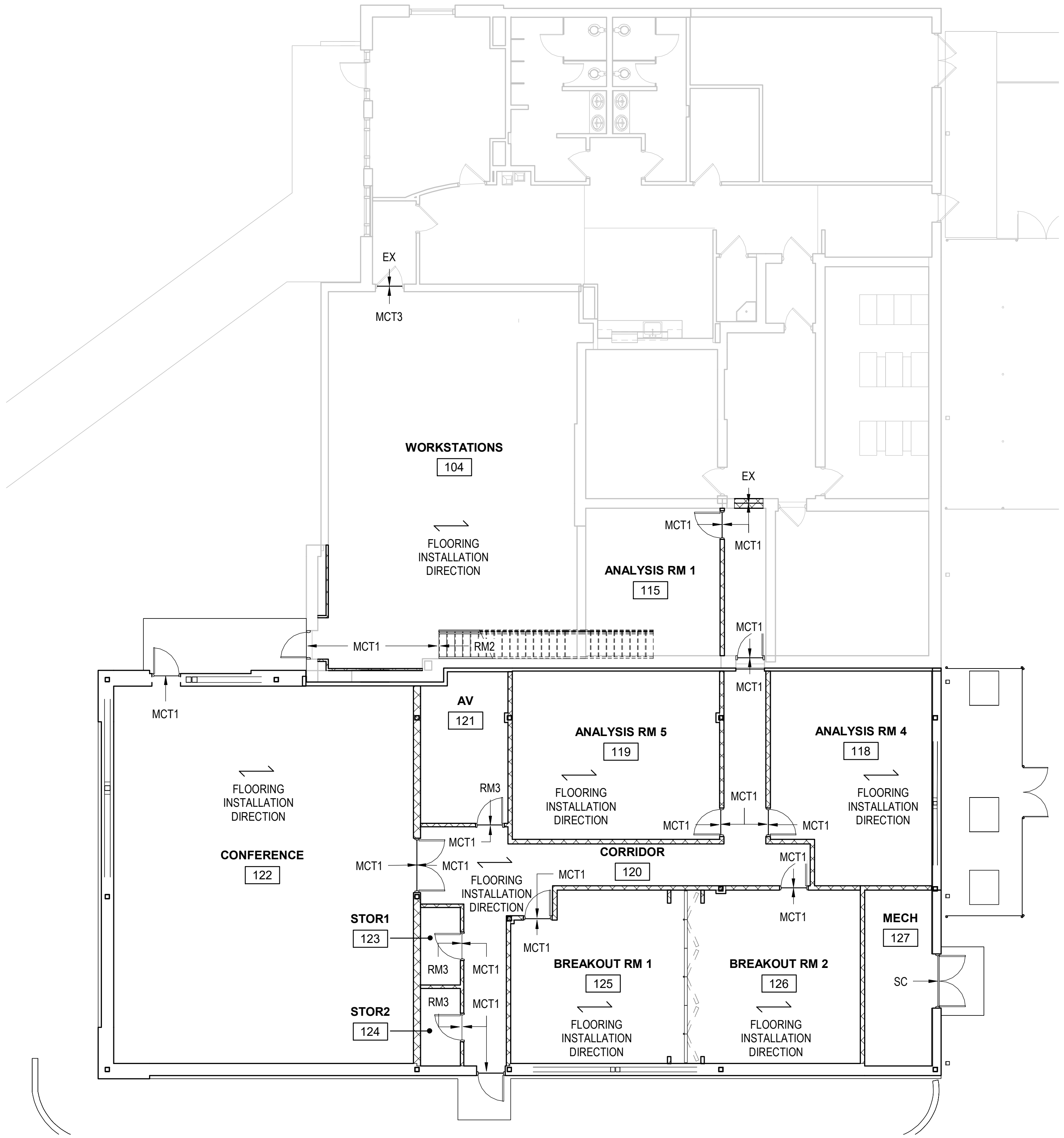
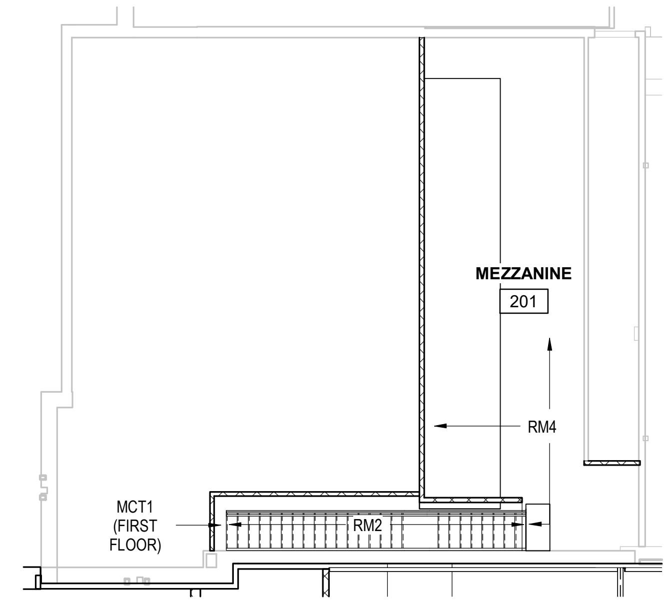
GENERAL NOTES

1. REFER TO REFLECTED CEILING PLAN SHEET A-150 FOR CEILING HEIGHTS.
2. REFER TO SHEET I-101 FOR EXTENT OF FLOOR FINISHES.
3. REFER TO SHEET I-601 FOR INTERIOR FINISH SCHEDULE AND LEGEND.
4. REFER TO SHEET I-103 FOR SIGNAGE AND CORNER GUARD PLANS.
5. ALL INTERIOR HOLLOW METAL DOORS AND FRAMES SHALL BE PAINTED PT2.
6. ALL ELECTRICAL SWITCHES, RECEPTACLES, VOICE AND DATA PLATES SHALL BE GREY.
7. INSTALL FLOOR FINISH MATERIAL WITH SCHLUTER SYSTEM (OR EQUAL) METAL EDGE TRIM AT JUNCTURE OF DISSIMILAR MATERIALS; I.E. PORCELAIN PAVER AND MODULAR CARPET TILE.
8. ALL EXPOSED STRUCTURE SHALL BE PAINTED PT4 .
9. CORNER GUARDS SHALL EXTEND FROM TOP OF WALL BASE TO CEILING. PROVIDE CORNER GUARDS AT ALL OUTSIDE CORNERS IN CORRIDORS.
10. AP (ACOUSTICAL PANELS) SHALL BE MOUNTED AT ________.
11. ALL CEILING MOUNTED DEVICES SHALL BE CENTERED ON THE ACOUSTICAL CEILING TILE.
12. FOR CMU WALLS, PROVIDE 2 COATS BLOCK FILLER AND 2 COATS SEMI-GLOSS PAINT.
13. FINISH SCHEDULE IS BASED ON PLAN NORTH.
14. PROVIDE TRANSITION TRIM WHERE TWO DIFFERENT FLOOR MATERIALS ADJOIN.
15. SEE WALL TYPE LEGEND FOR WALL SUBSTRATE.
16. INTERIOR AND EXTERIOR FINISH MATERIALS AND COLORS SHALL BE AS REFERENCED IN THE SPECIFICATION SECTION 09 06 00 SCHEDULE FOR FINISHES WHICH PROVIDES DETAILS INFORMATION OF THE FINISH CODES SHOWN ON THE FINISH LEGEND.
17. REFERENCE FINISH SPECIFICATION SECTIONS FOR THE BASIS OF DESIGN EQUIVALENT MANUFACTURER TECHNICAL REQUIREMENTS.
18. INTERIOR CAULKING TO MATCH ADJACENT WALL FINISH COLOR.
19. FLOORING INSTALLED IN EXISTING ANALYSIS ROOM AND ADJACENT CORRIDOR SHALL MATCH EXISTING DIRECTIONAL PATTERN. ALL OTHER AREAS RECEIVING MCT, INSTALL IN DIRECTION NOTED ON I-101.



PLAN NORTH
1 I-101
FINISH PLAN - NEW WORK
1/8" = 1'-0"



PLAN NORTH
2 I-101
FINISH PLAN - MEZZANINE NEW WORK
1/8" = 1'-0"

0 4' 8' 16'
SCALE: 1/8" = 1'-0"

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BASE CIVIL ENGINEER
EGLIN AIR FORCE BASE, FLORIDA

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APPROVED 96/CEG/CEN
APPROVED ENVIRONMENTAL
APPROVED DEPUTY BASE CIVIL ENGINEER

TITLE
ADDITION AND RENOVATION B521

CONTENTS
FINISH PLAN

INDEX NO.
I-101

SPEC. NO. 23AH
PROJ. NO. FTFA 23-MM06
DRAWING NO.
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FURNITURE SCHEDULE

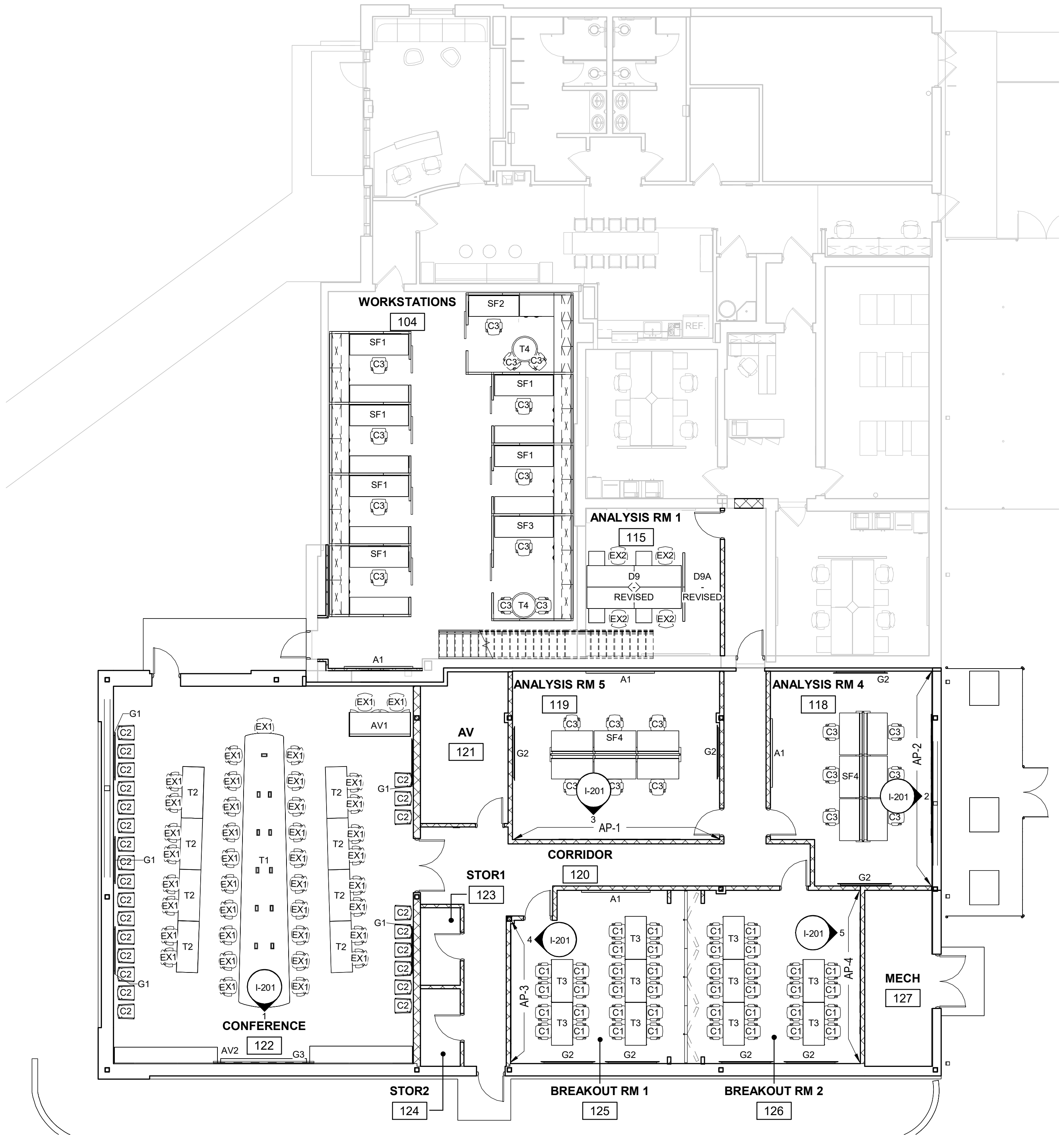
TYPE MARK	DESCRIPTION
A1	MARKER BOARD - 96"W x 48"H
AP1	ACOUSTICAL PANEL
AP2	ACOUSTICAL PANEL
AP3	ACOUSTICAL PANEL
AP4	ACOUSTICAL PANEL
AV1	AUDIO VISUAL CONTROL STATION
AV2	AUDIO VISUAL WALL WITH CREDENZAS
C1	SIT-STAND CHAIR WITH ARMS
C2	GUEST CHAIR
C3	TASK CHAIR
D9 - REVISED	ANALYSIS ROOM DESKING
D9A - REVISED	ANALYSIS ROOM DESKING
EX1	EXISTING CONFERENCE ROOM CHAIR
EX2	EXISTING TASK CHAIR
S1	SHELVING SYSTEM - 4'-0"W X 2'-0"D X 8'-0"H
SF1	U-SHAPED WORKSTATION - 9'-0" X 8'-0"
SF2	L-SHAPED WORKSTATION - 12'-0" X 9'-0"
SF3	L-SHAPED WORKSTATION - 9'-0" X 12'-0"
SF4	6 PERSON HEIGHT ADJUSTABLE BENCHING GROUP
T1	CONFERENCE ROOM TABLE 72" Wx26' Lx 30" H
T2	TABLE - 72"W X 30"D
T3	HIGH-TOP WORK TABLE ON CASTERS - 60"W X 30"D X 41"H
T4	ROUND TABLE - 3' DIAMETER
WB1	WORKBENCH - 72" x 36"

GFGI FURNITURE SCHEDULE

TYPE MARK	DESCRIPTION
G1	FLAT PANEL DISPLAY - 75"
G2	FLAT PANEL DISPLAY - 86"
G3	PROJECTION SCREEN

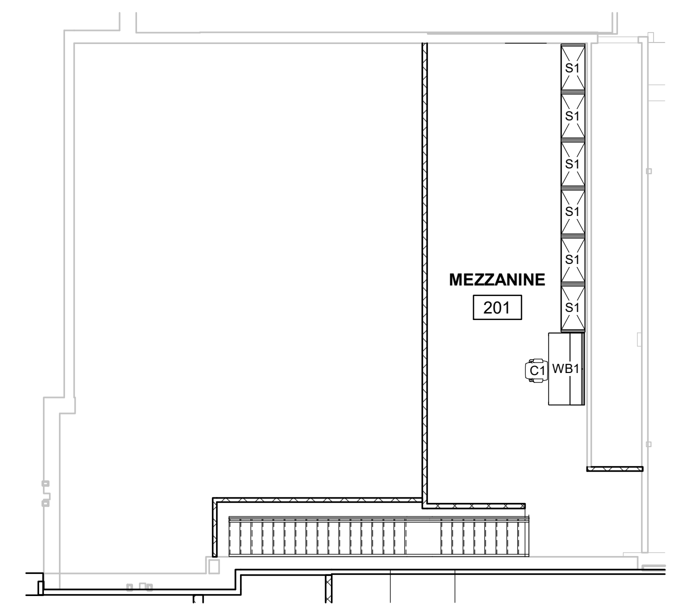
FURNITURE LEGEND

MARK	DESCRIPTION
A	ACCESSORIES
AV	AUDIOVISUAL EQUIPMENT
C	SEATING
D	DESKING
E	EQUIPMENT
EX	EXISTING FURNITURE ITEM
G	GOV'T FURNISHED / GOV'T INSTALLED (GFGI)
S	STORAGE
SF	SYSTEMS FURNITURE
T	TABLE
WB	WORKBENCH



PLAN NORTH

1 I-102 FURNITURE PLAN - NEW WORK
1/8" = 1'-0"



PLAN NORTH

2 I-102 FURNITURE PLAN - MEZZANINE NEW WORK
1/8" = 1'-0"

0 4' 8' 16'
SCALE: 1/8" = 1'-0"

BASE CIVIL ENGINEER
EGLIN AIR FORCE BASE, FLORIDA

DRAWN BY K. McMURRAY
PROJ. ENGR. J. SAWYER

TITLE: ADDITION AND RENOVATION B521

DATE
SIGNATURE

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APPROVED DIR. BASE MED. SERVICE
APPROVED SECURITY FORCES
APPROVED USING AGENCY
APPROVED ASUS
APPROVED COMMUNICATIONS
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APPROVED DEPUTY BASE CIVIL ENGINEER

CONTENTS: FURNITURE PLAN

DATE: 13 MARCH 2024
SCALE: AS SHOWN

INDEX NO. I-102
SPEC. NO. 23AH
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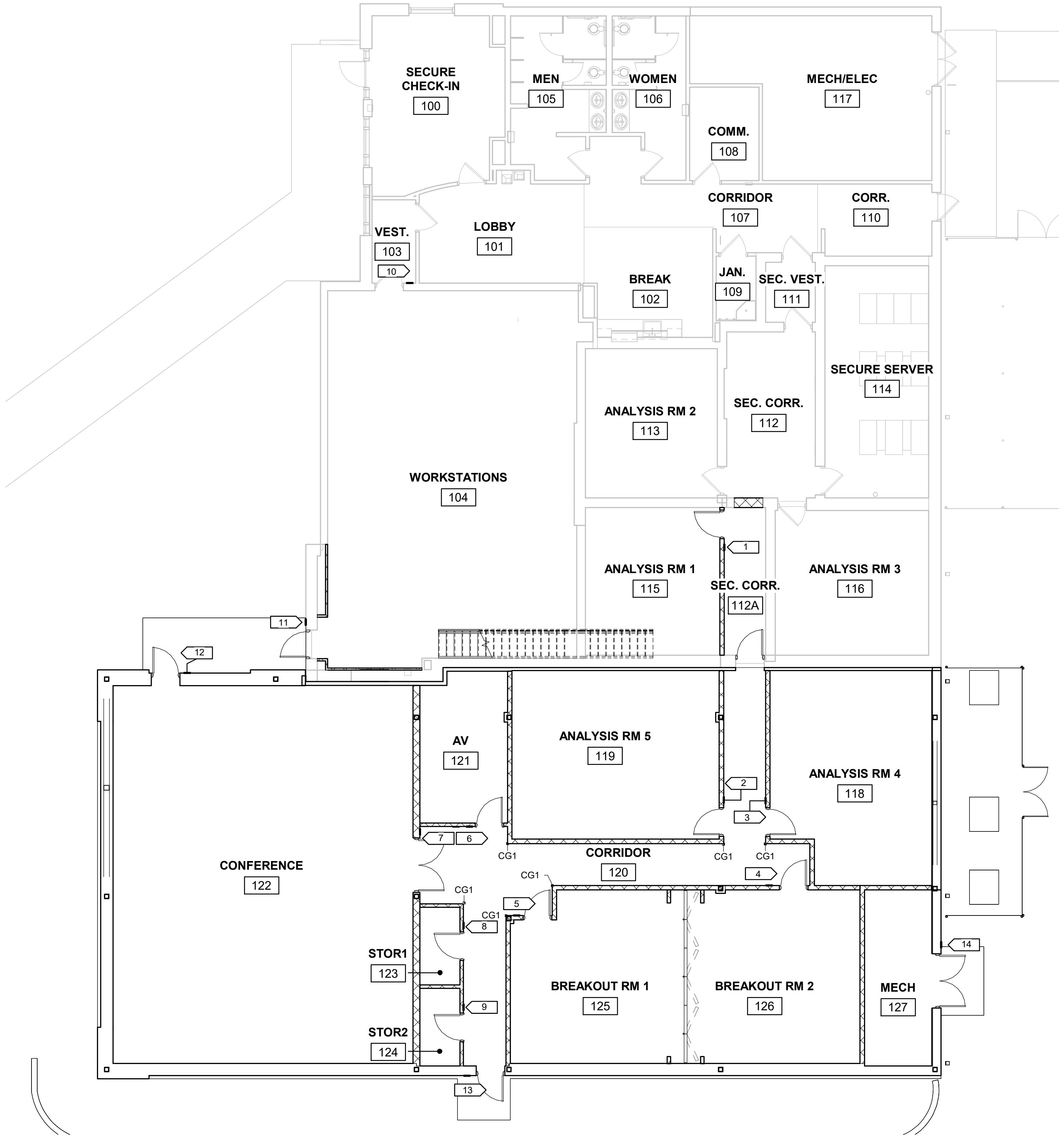
LEGEND

1	SIGNAGE DESIGNATION
┘	CORNER GUARD DESIGNATION - 90 DEGREE CORNER

SIGNAGE NOTES

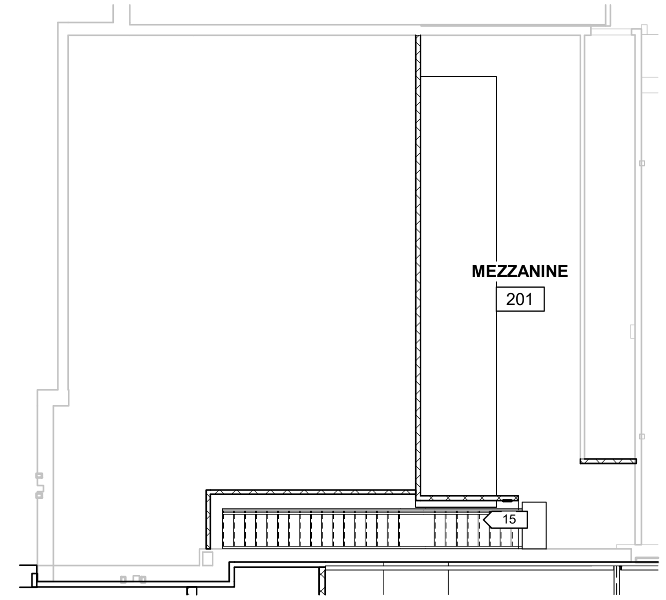
1. SIGNAGE SHALL BE FABRICATED AND INSTALLED IN ACCORDANCE WITH ADA/ABA GUIDELINES.
2. REFER TO FINISH SPECIFICATION SECTIONS FOR THE BASIS OF DESIGN EQUIVALENT MANUFACTURER'S TECHNICAL REQUIREMENTS.
3. REFER TO THE INTERIOR FINISH LEGEND ON SHEET I-601 FOR SIGNAGE FINISHES.
4. REFER TO SHEET I-602 FOR SIGNAGE MOUNTING TYPICAL AND DETAILS.
5. REFER TO SHEET I-103 FOR SIGNAGE LOCATION PLAN.
6. CONFIRM / COORDINATE COPY TEXT WITH USER BEFORE PURCHASING SIGNAGE.



PLAN NORTH

1 I-103 SIGNAGE PLAN - NEW WORK

1/8" = 1'-0"



PLAN NORTH

2 I-103 SIGNAGE PLAN - MEZZANINE NEW WORK

1/8" = 1'-0"

0 4' 8' 16'

SCALE: 1/8" = 1'-0"

65% DESIGN SUBMITTAL

BASE CIVIL ENGINEER
EGLIN AIR FORCE BASE, FLORIDA

DRAWN BY	K. McMURRAY
PROJ. ENGR.	J. SAWYER
TITLE	ADDITION AND RENOVATION B521
CONTENTS	SIGNAGE AND CORNER GUARD PLAN
DATE	13 MARCH 2024
SCALE	AS SHOWN
INDEX NO.	I-103
SPEC. NO.	23AH
PROJ. NO.	FTFA 23-MM06
DRAWING NO.	
FILE NO.	
SHEET	OF

DATE

SIGNATURE

APPROVED FIRE PREVENTION

APPROVED SAFETY REPRESENTATIVE

APPROVED DIR. BASE MED. SERVICE

APPROVED SECURITY FORCES

APPROVED USING AGENCY

APPROVED ASUS

APPROVED COMMUNICATIONS

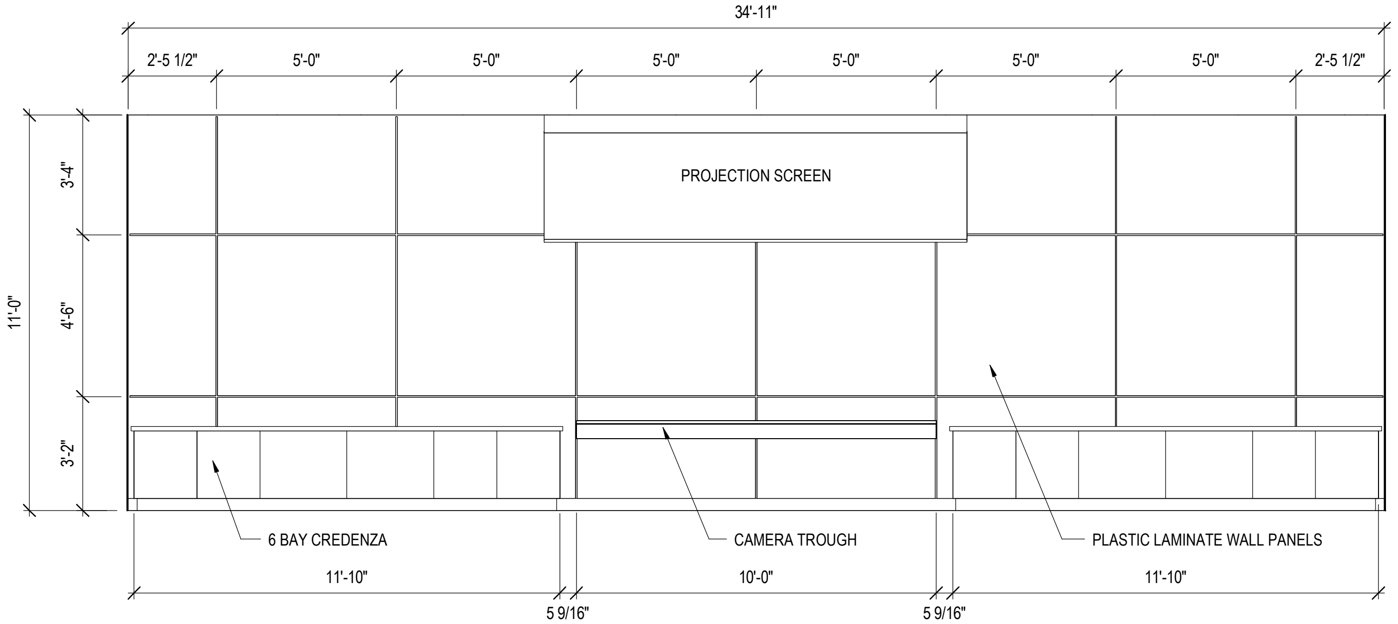
APPROVED CHELCO

APPROVED OPERATIONS ENGINEERING

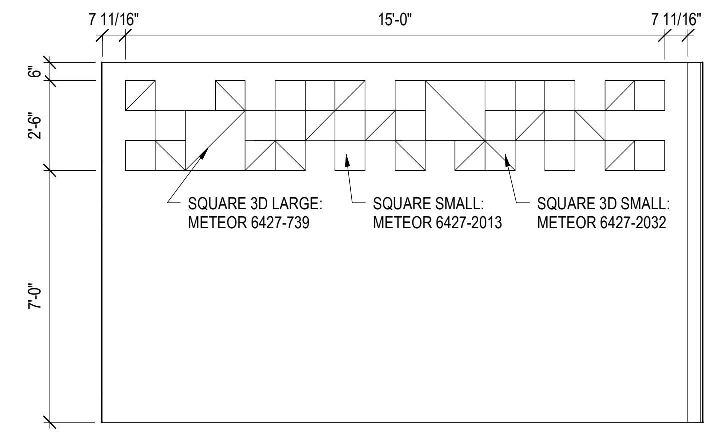
APPROVED 96/CEG/CEN

APPROVED ENVIRONMENTAL

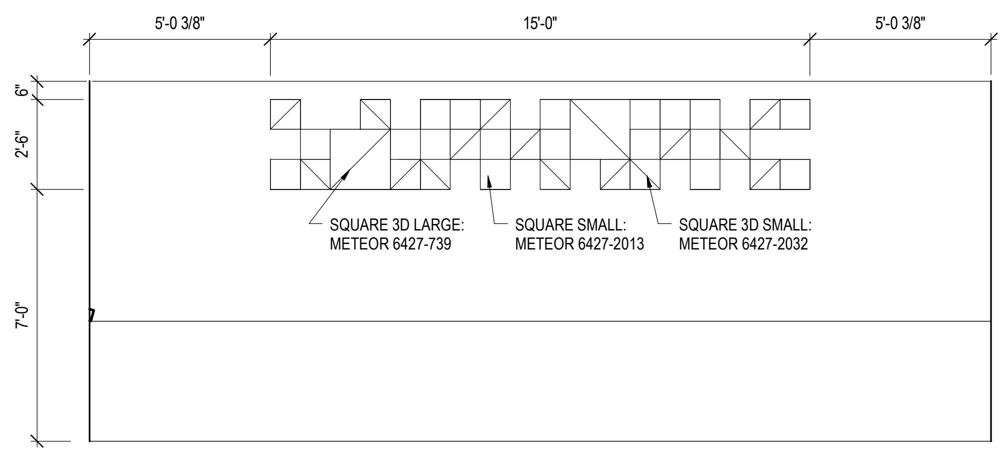
APPROVED DEPUTY BASE CIVIL ENGINEER



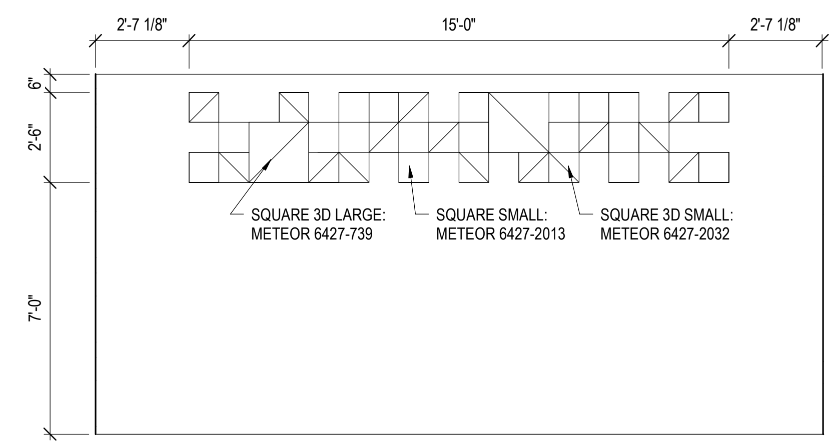
1 I-201 CONFERENCE ROOM 122 AV WALL ELEVATION
3/8" = 1'-0"



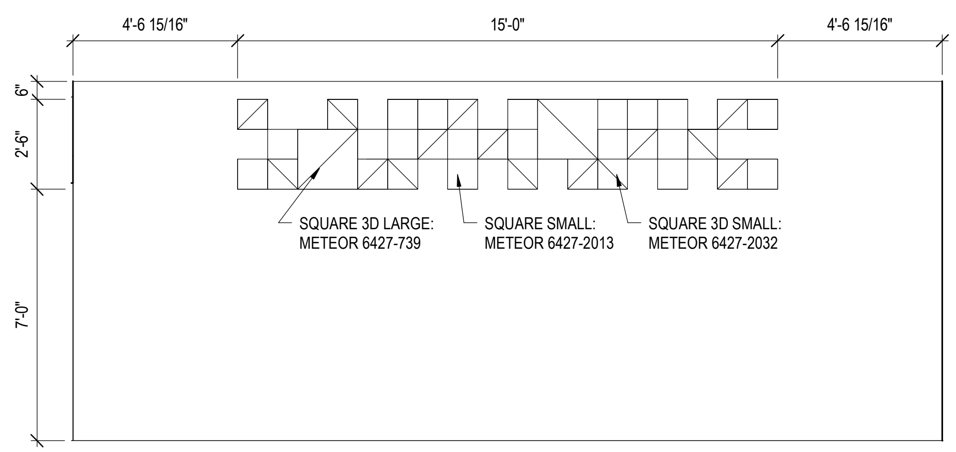
4 I-201 ACOUSTICAL PANEL ELEVATION - ROOM 125
3/8" = 1'-0"



2 I-201 ACOUSTICAL PANEL ELEVATION - ROOM 118
3/8" = 1'-0"



5 I-201 ACOUSTICAL PANEL ELEVATION - ROOM 126
3/8" = 1'-0"



3 I-201 ACOUSTICAL PANEL ELEVATION - ROOM 119
3/8" = 1'-0"

0 1'-4" 2'-8" 5'-4"
SCALE: 3/8" = 1'-0"

BASE CIVIL ENGINEER
EGLIN AIR FORCE BASE, FLORIDA

DATE
SIGNATURE

DRAWN BY K. McMURRAY
PROJ. ENGR. J. SAWYER
APPROVED
FIRE PREVENTION
APPROVED
SAFETY REPRESENTATIVE
APPROVED
DIR. BASE MED. SERVICE
APPROVED
USING AGENCY
APPROVED
COMMUNICATIONS
APPROVED
OPERATIONS ENGINEERING
APPROVED
ENVIRONMENTAL

APPROVED
SECURITY FORCES
APPROVED
ASUS
APPROVED
CHELCO

TITLE
ADDITION AND RENOVATION B521

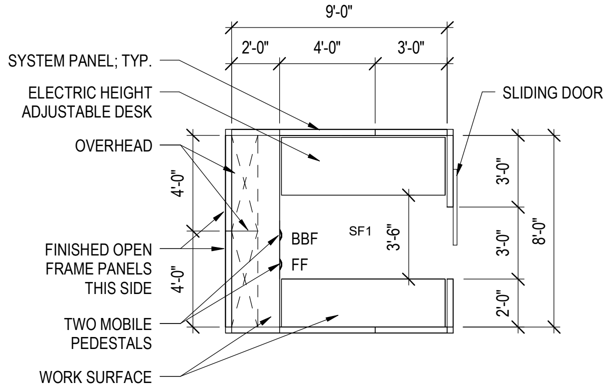
CONTENTS
INTERIOR ELEVATIONS

APPROVED
96/CEG/CEN
APPROVED
DEPUTY BASE CIVIL ENGINEER

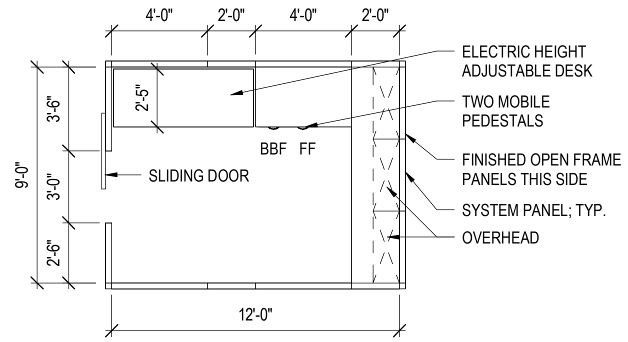
DATE 13 MARCH 2024
SCALE AS SHOWN

INDEX NO. I-201
SPEC. NO. 23AH
PROJ. NO. FTFA 23-MM06
DRAWING NO.
FILE NO.
SHEET OF

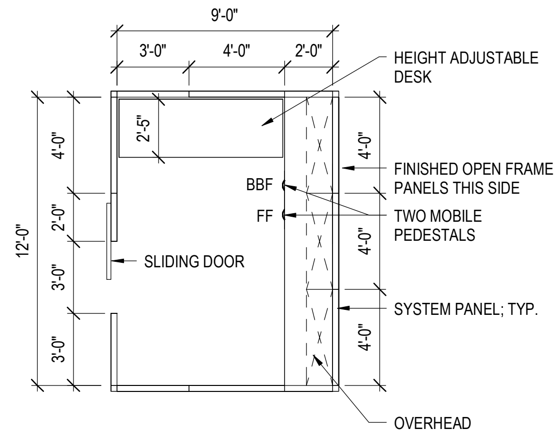
65% DESIGN SUBMITTAL



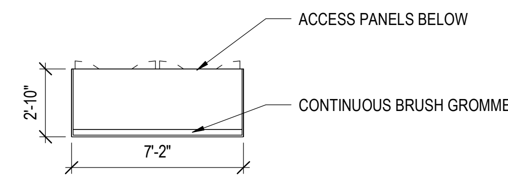
1 I-401 SF1- PLAN VIEW
1/4" = 1'-0"



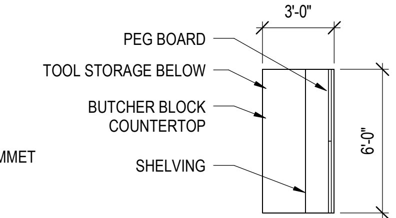
3 I-401 SF2- PLAN VIEW
1/4" = 1'-0"



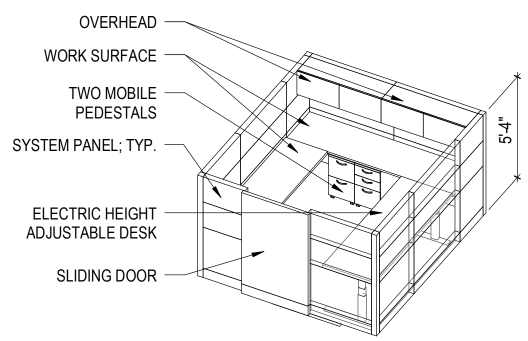
5 I-401 SF3- PLAN VIEW
1/4" = 1'-0"



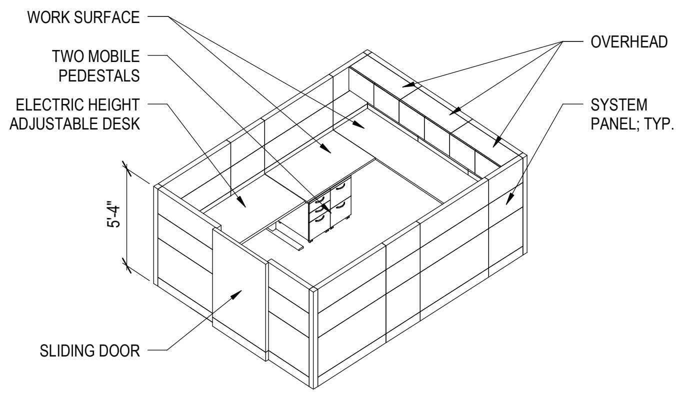
7 I-401 AV1- PLAN VIEW
1/4" = 1'-0"



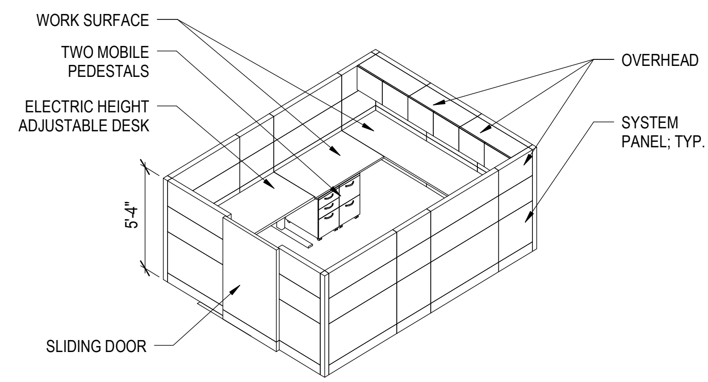
9 I-401 WB-1 -PLAN VIEW
1/4" = 1'-0"



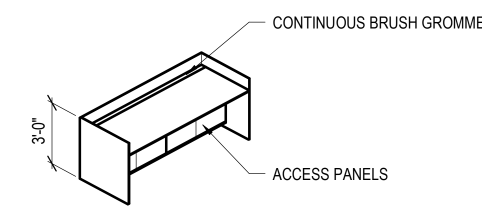
2 I-401 SF1- 3D VIEW



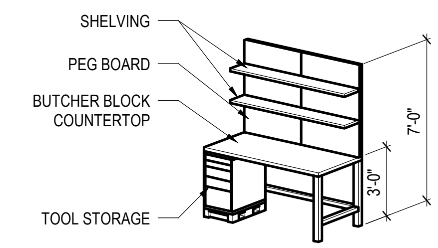
4 I-401 SF2- 3D VIEW



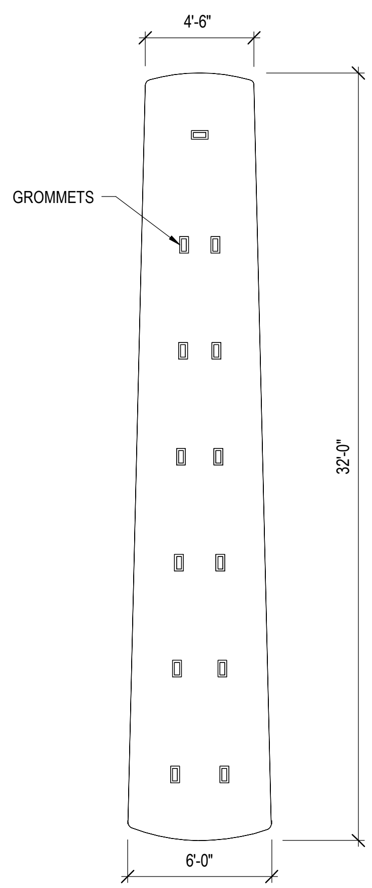
6 I-401 SF3- 3D VIEW



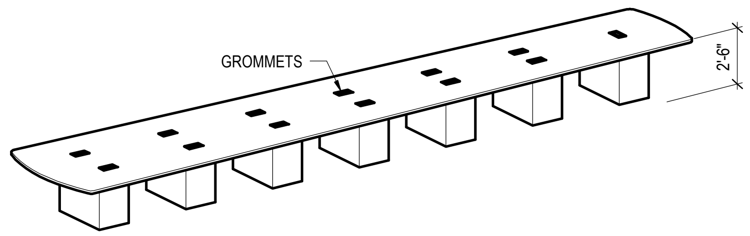
8 I-401 AV1- 3D VIEW



10 I-401 WB-1 3D VIEW



11 I-401 T1- PLAN VIEW
1/4" = 1'-0"



12 I-401 T1- 3D VIEW

65% DESIGN SUBMITTAL

BASE CIVIL ENGINEER
EGLIN AIR FORCE BASE, FLORIDA

DATE
SIGNATURE
DRAWN BY K. McMURRAY
PROJ. ENGR. J. SAWYER
APPROVED FIRE PREVENTION
APPROVED SAFETY REPRESENTATIVE
APPROVED DIR. BASE MED. SERVICE
APPROVED SECURITY FORCES
APPROVED USING AGENCY
APPROVED ASUS
APPROVED COMMUNICATIONS
APPROVED CHELCO
APPROVED OPERATIONS ENGINEERING
APPROVED 96/CEG/CEN
APPROVED ENVIRONMENTAL
APPROVED DEPUTY BASE CIVIL ENGINEER

TITLE
ADDITION AND RENOVATION B521

CONTENTS
FURNITURE TYPICALS

DATE 13 MARCH 2024
SCALE AS SHOWN

INDEX NO. I-401
SPEC. NO. 23AH
PROJ. NO. FTFA 23-MM06
DRAWING NO.
FILE NO.
SHEET OF

ROOM FINISH SCHEDULE

		FLOOR	BASE	WALLS				MILLWORK	CEILING	
				NORTH	EAST	SOUTH	WEST			
ROOM NO.	ROOM NAME	FIN - COLOR	FIN - COLOR	FIN - COLOR	FIN - COLOR	FIN - COLOR	FIN - COLOR	FIN - COLOR	FIN - COLOR	REMARKS
104	WORKSTATIONS	MCT-1	RM-1	PT-1	PT-1	PT-1	PT-1	---	ACT-1	
112A	SEC. CORR.	MCT-1	RM-1	PT-1	PT-1	PT-1	PT-1	---	ACT-1	
115	ANALYSIS RM 1	MCT-1	RM-1	PT-1	PT-1	PT-1	PT-1	---	ACT-1	
118	ANALYSIS RM 4	MCT-1	RM-1	PT-1	PT-1	PT-1	PT-1	---	ACT-1	
119	ANALYSIS RM 5	MCT-1	RM-1	PT-1	PT-1	PT-1	PT-1	---	ACT-1	
120	CORRIDOR	MCT-1	RM-1	PT-1	PT-1	PT-1	PT-1	---	ACT-1	
121	AV	RM-3	RM-1	PT-1	PT-1	PT-1	PT-1	---	ACT-1	
122	CONFERENCE	MCT-1	RM-1	PT-1	PT-1	WD-2 / AP-1	PT-1	---	GWB - PT-6, PT-7 / ACT-2	
123	STOR1	RM-3	RM-1	PT-1	PT-1	PT-1	PT-1	---	ACT-1	
124	STOR2	RM-3	RM-1	PT-1	PT-1	PT-1	PT-1	---	ACT-1	
125	BREAKOUT RM 1	MCT-1	RM-1	PT-1	PT-1	PT-1	PT-1	---	ACT-1	
126	BREAKOUT RM 2	MCT-1	RM-1	PT-1	PT-1	PT-1	PT-1	---	ACT-1	
127	MECH	SC-1	RM-1	PT-3	PT-3	PT-3	PT-3	---	GWB - PT-5	
201	MEZZANINE	RM-3	RM-1	PT-1	PT-1	PT-1	PT-1	---	EXP - PT-4	

INTERIOR FINISH LEGEND

UFGS SPEC NUMBER	MATERIAL CODE	DESCRIPTION	BASIS OF DESIGN MANUFACTURER	PRODUCT / STYLE NUMBER / SIZE	COLOR NAME / NUMBER	ADDITIONAL COMMENTS
1 - INTERIOR FLOOR FINISHES						
	MCT-1	MODULAR CARPET TILE	BENTLEY	COLLECTION - ARCADE LENGEND; NEXSTEP CUSHION BACKING; SIZE: 18" X 36"; INSTALLATION METHOD: BRICK	TIGER PATROL 800606	
	RM-2	RUBBER STAIR TREADS, RISERS, AND LANDING	TARKETT	JOHNSONITE COLOR SPLASH RUBBER TREADS, RISERS, AND LANDING; HAMMERED FINISH; WITH 55 SILVER GREY GRIT TAPE	VIHNTRSP VH1 5' SQ GREY TAPE NON-STK	
	RM-3	RESILIENT FLOORING	AMERICAN BILTRITE	ELECTROTILE; SDT-135, 12" X 12" X 1/8" THICK	GREY	
	RM-4	RESILIENT FLOORING	AMERICAN BILTRITE	TEXAS GRANITE, VTG-199, 12" X 12"X 1/8" THICK	CAROLINA SAILING	
	SC	SEALED CONCRETE	H & C	CLARISHIELD WATER-BASED SEALER; NATURAL LOOK	CLEAR SEALER	
2 - INTERIOR BASE FINISHES						
	RM-1	RUBBER WALL BASE	JOHNSONITE	DURACOVE THERMOSET RUBBER COVE BASE 6" HIGH	DEEP NAVY 139	
3 - INTERIOR WALL FINISHES						
	AP-1	ACOUSTICAL WALL PANELS	KIREI	FELT PANELS;		
	OP-1	OPERABLE PARTITION	MODERNFOLD	PAIRED PANELS; LEGACY 52 STC, FABRIC PANELS	FABRIC, CARNEGIE XOREL; TANGLE, 6213-7, TRIM - MATCH SHERWIN WILLIAMS SMOKE GREY, MATCH SMOKE GREY	
	PT-1	PAINT - WALLS	SHERWIN WILLIAMS	EGGSHELL FINISH	LAZY GREY SW6254	
	PT-3	PAINT - WALLS	SHERWIN WILLIAMS	FINISH: SEMI-GLOSS	WHITE	
4 - INTERIOR CEILING FINISHES						
	ACT-1	ACOUSTICAL CEILING TILE	ROCKFON	PRODUCT: TROPIC; SIZE:24" X 24" X 5/8"; SQUARE TEGULAR; CHICAGO METALLIC GRID SYSTEM 1200 HRC:15/16"; COLOR: WHITE	WHITE	
	ACT-2	ACOUSTICAL CEILING TILE	ARMSTRONG CEILING SOLUTIONS	PRODUCT: OPTIMA 3256PB; SIZE: 48" X 48" X 1"; SQUARE TEGULAR; GRID SYSTEM: SUPRAFINE; COLOR: WHITE	WHITE	
	EXP-1	EXPOSED STRUCTURE - PAINTED	SHERWIN WILLIAMS	FINISH: SEMI-GLOSS	CEILING BRIGHT WHITE SW7007	
	PT-4	PAINT - CEILING	SHERWIN WILLIAMS	FINISH: SEMI-GLOSS	MINERAL GRAY SW2740	
	PT-5	PAINT - CEILING	SHERWIN WILLIAMS	FINISH: FLAT	CEILING BRIGHT WHITE SW7007	
	PT-6	PAINT - CEILING	SHERWIN WILLIAMS	FINISH: FLAT	REFLECTIONS SW7661	
	PT-7	PAINT - CEILING	SHERWIN WILLIAMS	FINISH: FLAT	MORNING FOG SW6255	
5 - INTERIOR TRIM						
	CG-1	CORNER GUARD	INPRO	FINISH: VELOUR TEXTURE	GRAYSTONE 0151	
	PT-2	PAINT - HOLLOW METAL DOORS AND TRIM	SHERWIN WILLIAMS	FINISH: SEMI-GLOSS	MORNING FOG SW6255	
6 - INTERIOR MISCELLANEOUS						
	PT-8	PAINT - STAIR RAILING AND STRINGER	SHERWIN WILLIAMS	FINISH: SEMI-GLOSS	MINERAL GRAY SW2740	
	WD-1	WOOD DOORS	GRAHAM WOOD DOORS	PLAIN SLICED WHITE BIRCH; BOOK MATCHED	MIDNIGHT 850	
	WD-2	WOOD PANEL				
7 - INTERIOR SIGNAGE						
	IS	INTERIOR SIGNAGE - FACE MATERIAL	TAKEFORM	PLASTIC LAMINATE: WILSONART	INDIGO D379K-60	
	IS	INTERIOR SIGNAGE - RAISED COPY	TAKEFORM	---	BLACK	
	IS	INTERIOR SIGNAGE - BACKER PLATE	TAKEFORM	PLASTIC LAMINATE: NEVAMAR	SILVER ALU METALX MXT003-T	
	IS	INTERIOR SIGNAGE - METAL ACCENT BAR	TAKEFORM	---	BLACK	
	IS	INTERIOR SIGNAGE - INSERT BACKGROUND	TAKEFORM	CARDSTOCK	WHITE	
	IS	INTERIOR SIGNAGE - FONT STYLE	TAKEFORM	---	HELVETICA	
	IS	INTERIOR SIGNAGE - INSERT TEXT	TAKEFORM	---	BLACK	

ROOM FINISH ABBR. KEY

ACT -	ACOUSTICAL CEILING TILE	GWB -	GYPSUM WALLBOARD
AP -	ACOUSTICAL PANELS	IS -	INTERIOR SIGNAGE
CG -	CORNER GUARD	MCT -	MODULAR CARPET TILE
CMU -	CONCRETE MASONRY UNIT	PT -	PAINT
CONC -	CONCRETE	RM -	RESILIENT MATERIAL
EX -	EXISTING CONSTRUCTION	SC -	SEALED CONCRETE
EXP -	EXPOSED STRUCTURE	WD -	WOOD

GENERAL NOTES

1. REFER TO REFLECTED CEILING PLAN SHEET A-150 FOR CEILING HEIGHTS.
2. REFER TO SHEET I-101 FOR EXTENT OF FLOOR FINISHES.
3. REFER TO SHEET I-601 FOR INTERIOR FINISH SCHEDULE AND LEGEND.
4. REFER TO SHEET I-103 FOR SIGNAGE AND CORNER GUARD PLANS.
5. ALL INTERIOR HOLLOW METAL DOORS AND FRAMES SHALL BE PAINTED PT2.
6. ALL ELECTRICAL SWITCHES, RECEPTACLES, VOICE AND DATA PLATES SHALL BE GREY.
7. INSTALL FLOOR FINISH MATERIAL WITH SCHLUTER SYSTEM (OR EQUAL) METAL EDGE TRIM AT JUNCTURE OF DISSIMILAR MATERIALS; I.E. PORCELAIN PAVER AND MODULAR CARPET TILE.
8. ALL EXPOSED STRUCTURE SHALL BE PAINTED PT4 .
9. CORNER GUARDS SHALL EXTEND FROM TOP OF WALL BASE TO CEILING. PROVIDE CORNER GUARDS AT ALL OUTSIDE CORNERS IN CORRIDORS.
10. AP (ACOUSTICAL PANELS) SHALL BE MOUNTED AT ________.
11. ALL CEILING MOUNTED DEVICES SHALL BE CENTERED ON THE ACOUSTICAL CEILING TILE.
12. FOR CMU WALLS, PROVIDE 2 COATS BLOCK FILLER AND 2 COATS SEMI-GLOSS PAINT.
13. FINISH SCHEDULE IS BASED ON PLAN NORTH.
14. PROVIDE TRANSITION TRIM WHERE TWO DIFFERENT FLOOR MATERIALS ADJOIN.
15. SEE WALL TYPE LEGEND FOR WALL SUBSTRATE.
16. INTERIOR AND EXTERIOR FINISH MATERIALS AND COLORS SHALL BE AS REFERENCED IN THE SPECIFICATION SECTION 09 06 00 SCHEDULE FOR FINISHES WHICH PROVIDES DETAILS INFORMATION OF THE FINISH CODES SHOWN ON THE FINISH LEGEND.
17. REFERENCE FINISH SPECIFICATION SECTIONS FOR THE BASIS OF DESIGN EQUIVALENT MANUFACTURER TECHNICAL REQUIREMENTS.
18. INTERIOR CAULKING TO MATCH ADJACENT WALL FINISH COLOR.
19. FLOORING INSTALLED IN EXISTING ANALYSIS ROOM AND ADJACENT CORRIDOR SHALL MATCH EXISTING DIRECTIONAL PATTERN. ALL OTHER AREAS RECEIVING MCT, INSTALL IN DIRECTION NOTED ON I-101.

FINISH SCHEDULE REMARKS

1. EXISTING FINISH SHALL REMAIN.
2. PATCH AND REPAIR ADJACENT WALLS DUE TO DEMOLITION. PAINT SHALL MATCH EXISTING.
3. CLEAN AND PREP ALL EXISTING SURFACES FOR NEW FINISH.

65% DESIGN SUBMITTAL

BASE CIVIL ENGINEER
EGLIN AIR FORCE BASE, FLORIDA

DATE ________
SIGNATURE ________

DRAWN BY K. McMURRAY
PROJ. ENGR. L. SAWYER

TITLE
ADDITION AND RENOVATION B521

APPROVED ________ FIRE PREVENTION
APPROVED ________ SAFETY REPRESENTATIVE
APPROVED ________ DIR. BASE MED. SERVICE
APPROVED ________ SECURITY FORCES
APPROVED ________ USING AGENCY
APPROVED ________ ASUS
APPROVED ________ COMMUNICATIONS
APPROVED ________ CHELCO
APPROVED ________ OPERATIONS ENGINEERING
APPROVED ________ 96/CEG/CEN
APPROVED ________ ENVIRONMENTAL
APPROVED ________ DEPUTY BASE CIVIL ENGINEER

CONTENTS
FINISH SCHEDULE, NOTES, AND DETAILS

DATE 13 MARCH 2024
SCALE AS SHOWN

INDEX NO. I-601
SPEC. NO. 23AH
PROJ. NO. FTFA 23-MM06
DRAWING NO.
FILE NO.
SHEET OF

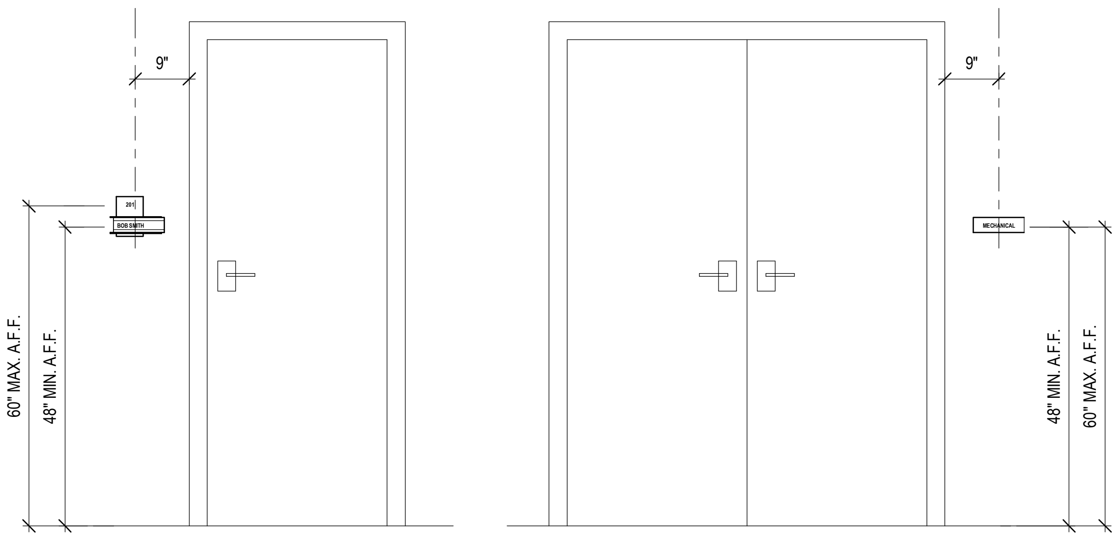
SIGNAGE SCHEDULE

MARK	ROOM NUMBER	ROOM NAME	PERMANENT COPY	CHANGEABLE COPY	TYPE	MOUNT LOCATION
1	115	ANALYSIS RM 1	---	ANALYSIS ROOM	TYPE A	INTERIOR WALL
2	119	ANALYSIS RM 5	---	ANALYSIS ROOM	TYPE A	INTERIOR WALL
3	118	ANALYSIS RM 4	---	ANALYSIS ROOM	TYPE A	INTERIOR WALL
4	126	BREAKOUT RM 2	---	BREAKOUT ROOM	TYPE A	INTERIOR WALL
5	125	BREAKOUT RM 1	---	BREAKOUT ROOM	TYPE A	INTERIOR WALL
6	121	AV	AV ROOM	---	TYPE B	INTERIOR WALL
7	122	CONFERENCE	---	CONFERENCE ROOM	TYPE D	INTERIOR WALL
8	123	STOR1	STORAGE	---	TYPE B	INTERIOR WALL
9	124	STOR2	STORAGE	---	TYPE B	INTERIOR WALL
10	104	WORKSTATIONS	---	OFFICES	TYPE A	INTERIOR WALL
11	104	WORKSTATIONS	NO ENTRY	---	TYPE C	EXTERIOR WALL
12	122	CONFERENCE	NO ENTRY	---	TYPE C	EXTERIOR WALL
13	120	CORRIDOR	NO ENTRY	---	TYPE C	EXTERIOR WALL
14	127	MECH	MECHANICAL	---	TYPE C	EXTERIOR WALL
15	201	MEZZANINE	MAXIMUM CAPACITY - ##		TYPE C	EXTERIOR WALL

SIGNAGE NOTES

1. SIGNAGE SHALL BE FABRICATED AND INSTALLED IN ACCORDANCE WITH ADA/ABA GUIDELINES.
2. REFER TO FINISH SPECIFICATION SECTIONS FOR THE BASIS OF DESIGN EQUIVALENT MANUFACTURER'S TECHNICAL REQUIREMENTS.
3. REFER TO THE INTERIOR FINISH LEGEND ON SHEET I-601 FOR SIGNAGE FINISHES.
4. REFER TO SHEET I-602 FOR SIGNAGE MOUNTING TYPICAL AND DETAILS.
5. REFER TO SHEET I-103 FOR SIGNAGE LOCATION PLAN.
6. CONFIRM / COORDINATE COPY TEXT WITH USER BEFORE PURCHASING SIGNAGE.

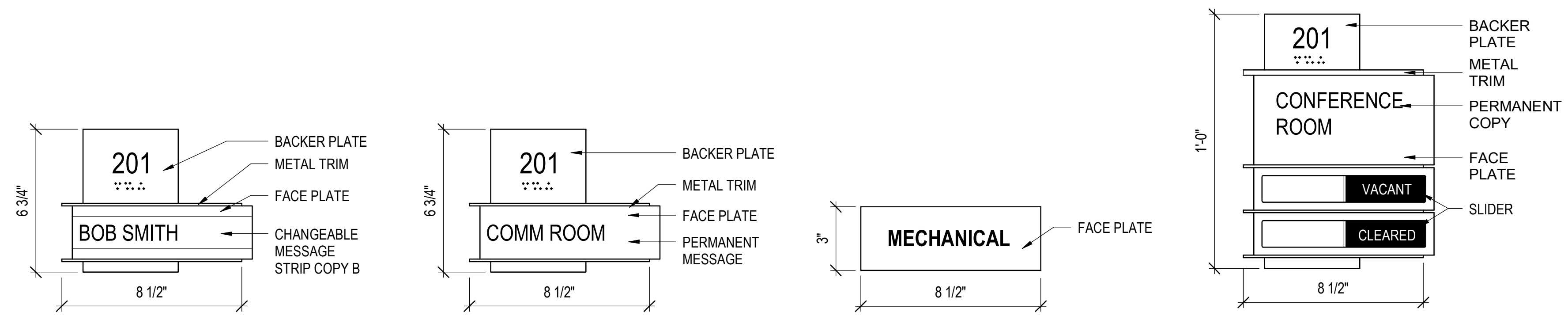
SIGN TYPE MOUNTING TYPICAL



ADA-ABA SIGN INSTALLATION HEIGHT AND LOCATION

ADA-ABA SIGN INSTALLATION HEIGHT AND LOCATION. IF ONE DOOR IS INACTIVE SIGN MAY BE CENTERED ON INACTIVE DOOR. IF BOTH DOORS ARE ACTIVE, SIGN SHALL HANG TO THE RIGHT OF THE DOORS.

SIGN TYPES - BASIS OF DESIGN: TAKEFORM FUSION 51



SIGN TYPE "A"

USE FOR ALL OFFICES AND ROOMS NOT SPECIFICALLY LISTED AS TYPES B & C. SIGNS WILL HAVE ROOM NUMBERS, BRAILLE, AND ONE CHANGEABLE MESSAGE SLOT. SEE SIGN TYPE MOUNTING TYPICAL FOR MOUNTING REQUIREMENTS.

SIGN TYPE "B"

USE FOR ALL OFFICES AND ROOMS NOT SPECIFICALLY LISTED AS TYPES A & C. SIGNS WILL HAVE ROOM NUMBERS, BRAILLE, AND ONE PERMANENT MESSAGE. SEE SIGN TYPE MOUNTING TYPICAL FOR MOUNTING REQUIREMENTS.

SIGN TYPE "C"

PROVIDE EXTERIOR GRADE SIGN FOR EXTERIOR LOCATIONS NOTED ON SCHEDULE. SEE SIGN TYPE MOUNTING TYPICAL FOR MOUNTING REQUIREMENTS.

SIGN TYPE "D"

CONFERENCE ROOM SIGN WILL HAVE ROOM NUMBERS, BRAILLE, A VACANT / IN-USE SLIDER AND A CLEARED / UNCLEAR SLIDER. SEE SIGN TYPE MOUNTING TYPICAL FOR MOUNTING REQUIREMENTS.

0 2" 4" 8"
SCALE: 3" = 1'-0"

65% DESIGN SUBMITTAL

BASE CIVIL ENGINEER
EGLIN AIR FORCE BASE, FLORIDA

DRAWN BY K. McMURRAY
PROJ. ENGR. J. SAWYER
DATE
SIGNATURE
APPROVED FIRE PREVENTION
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APPROVED OPERATIONS ENGINEERING
APPROVED 96/CEG/CEN
APPROVED ENVIRONMENTAL
APPROVED DEPUTY BASE CIVIL ENGINEER

TITLE: ADDITION AND RENOVATION B521

CONTENTS: SIGNAGE SCHEDULE, NOTES, AND DETAILS

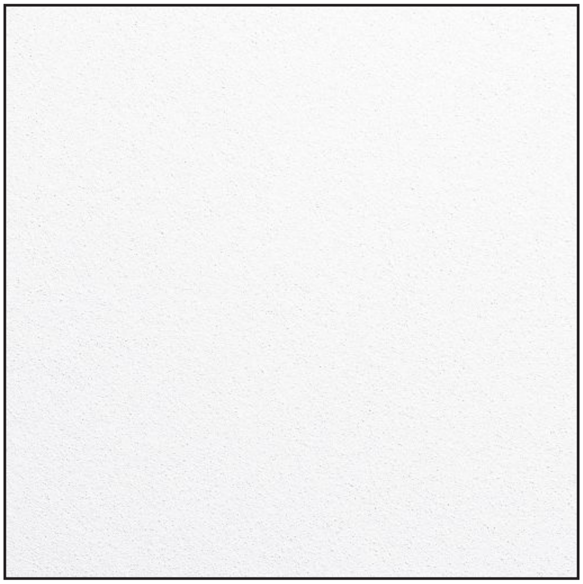
DATE: 13 MARCH 2024
SCALE: AS SHOWN
INDEX NO. I-602
SPEC. NO. 23AH
PROJ. NO. FTFA 23-MM06
DRAWING NO.
FILE NO.
SHEET OF

FINISH BOARDS

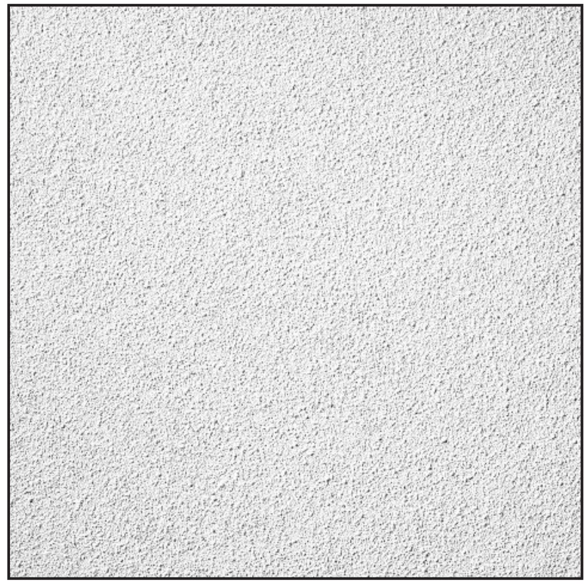
BULLOCK TICE ASSOCIATES
909 EAST CERVANTES STREET
PENSACOLA, FLORIDA 32501
850 - 434-5444 PHONE
850 - 432-5208 FAX

ADDITION AND RENOVATION B521

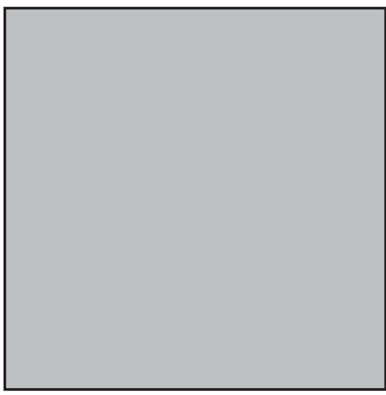
STRUCTURAL INTERIOR DESIGN FINISH BOARD



ACT-1 - ACOUSTICAL CEILING TILE

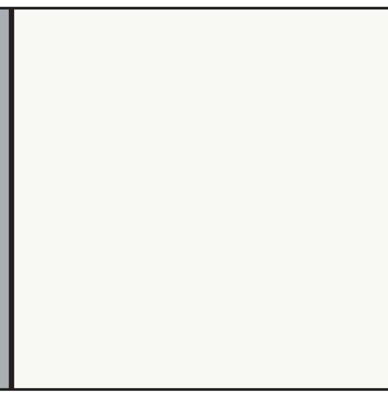


ACT-2 - ACOUSTICAL CEILING TILE



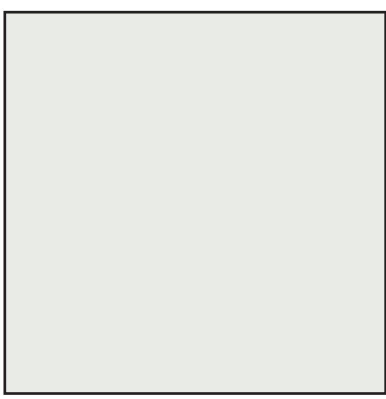
PT-1 - WALLS

PT-2 - TRIM
PT-7 - CEILING

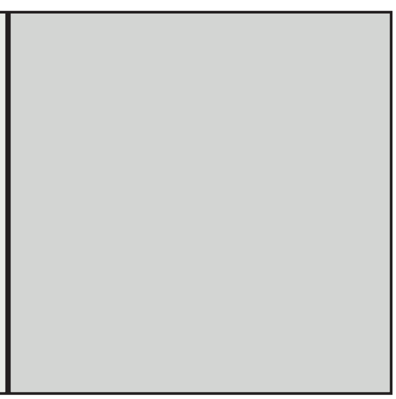


PT-3 - WALLS

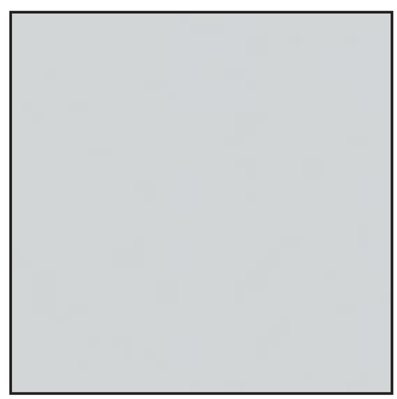
PT-4 - CEILING
PT-8 - STAIR RAILING



PT-5 - CEILING



PT-6 - CEILING

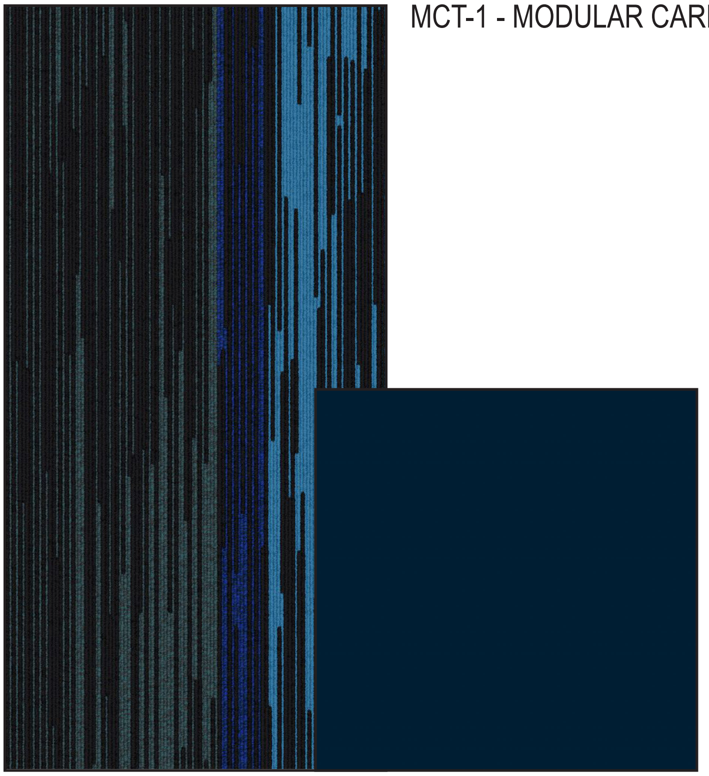


CG-1 - CORNER GUARD

BTA
A GHC COMPANY

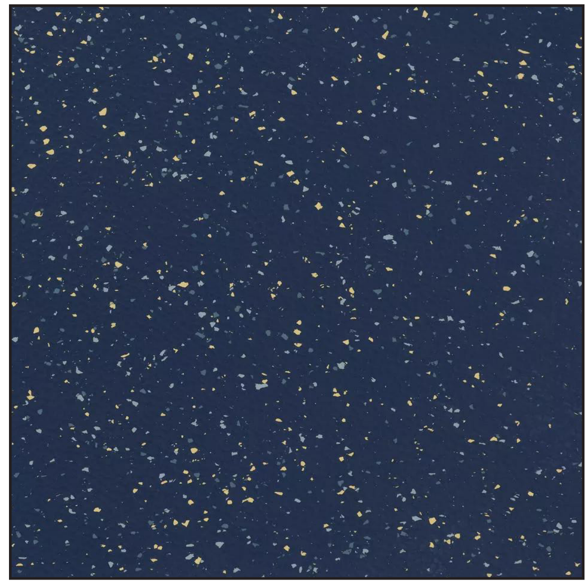
ADDITION AND RENOVATION B521

STRUCTURAL INTERIOR DESIGN FINISH BOARD

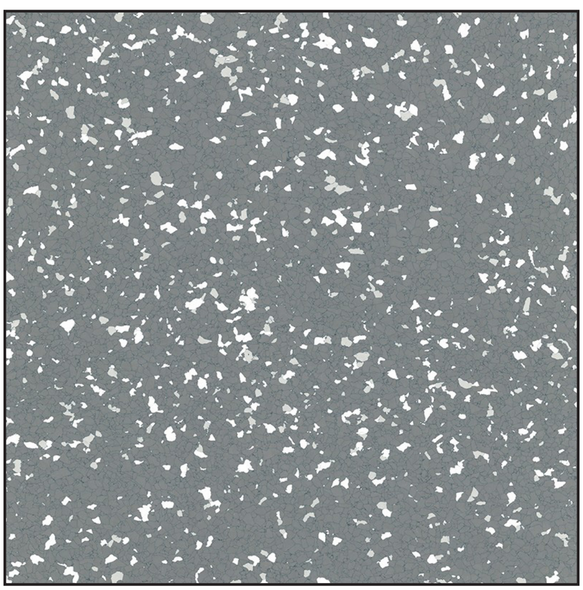


MCT-1 - MODULAR CARPET TILE

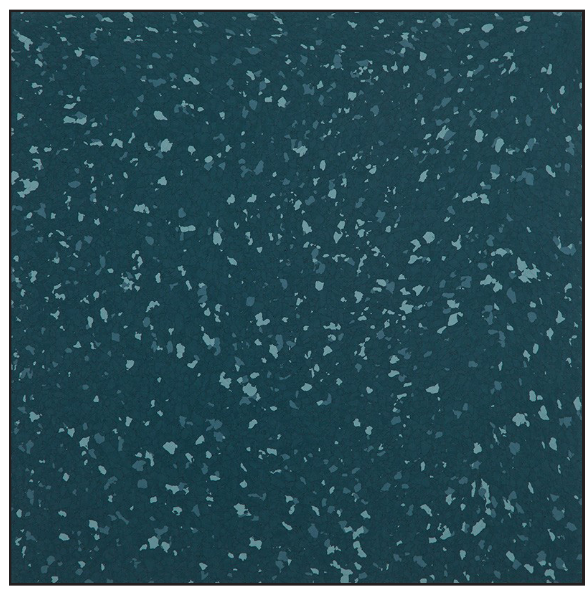
RM-1 - RUBBER WALL BASE



RM-2 - RUBBER STAIR TREADS, RISERS, & LANDING



RM-3 - RESILIENT FLOORING



RM-4 - RESILIENT FLOORING

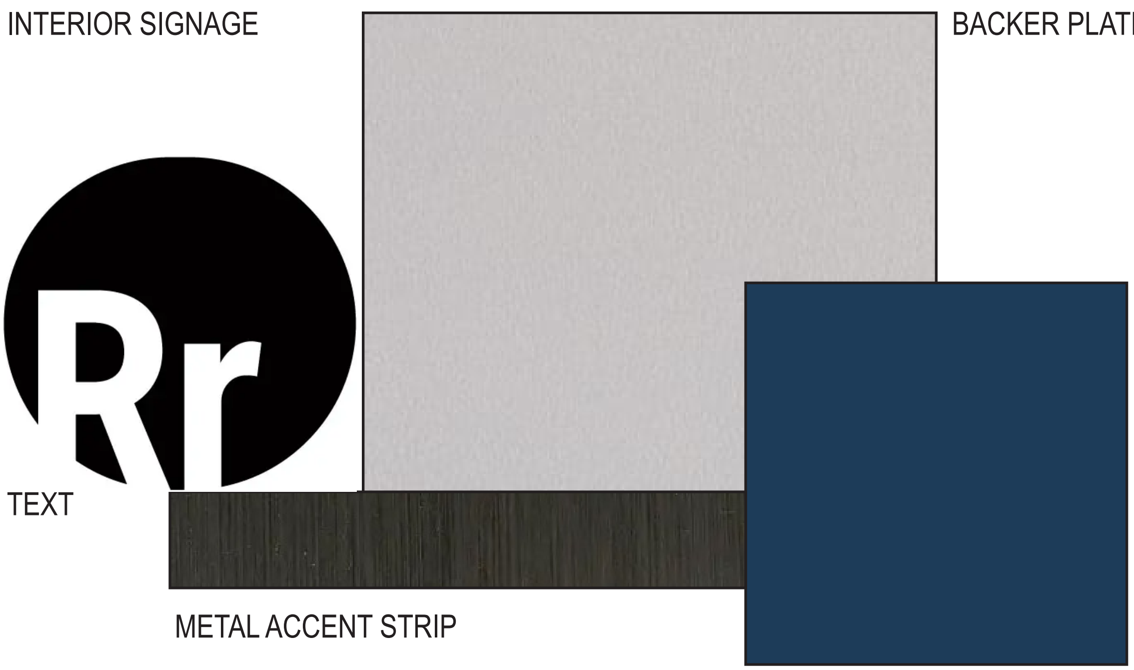
ADDITION AND RENOVATION B521

STRUCTURAL INTERIOR DESIGN FINISH BOARD

OP1 - OPERABLE PARTITION PANEL FABRIC & TRIM

INTERIOR SIGNAGE

BACKER PLATE



FACE PLATE

TEXT

METAL ACCENT STRIP

TECHNICAL INFORMATION

ULTIMA®
ULTIMA® High NRC

Tegular
fine texture

TOTAL ACOUSTICS®
Sound Absorption (NRC) + Sound Blocking (CAC)

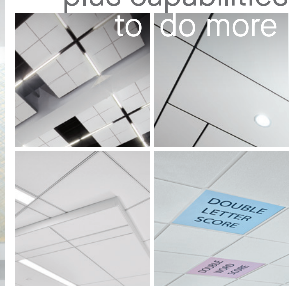
SUSTAIN®
High Performance Sustainable Ceiling Systems

Ultima® Beveled Tegular panels with Silhouette® 1/4" reveal 9/16" suspension system

CAD/Revit® drawings at:
armstrongceilings.com/cadrevit

DESIGNFlex®
A New World of Choice for Ceiling Systems

plus capabilities to do more



armstrongceilings.com/capabilities
See more photos at:
armstrongceilings.com/photogallery

Smooth-texture panels that are washable, impact- and scratch-resistant with a non-directional visual.
Offer both Sustain® and Total Acoustics® panel performance for flexible spaces.

KEY SELECTION ATTRIBUTES

- DesignFlex® options include shapes and made-to-order sizes available to ship in 3 weeks
- Get total noise control and floor plan versatility with Total Acoustics® ceiling panels: NRC + CAC = Total Acoustics performance
- Ultima® panels are part of the Sustain® portfolio, and meet the most stringent industry sustainability compliance standards today
- new High sound absorption options available up to 0.85 NRC
- CleanAssure™ family of products – includes disinfectable panels, suspension systems, and trim
- Mold- and mildew-resistant surface
- Smooth, clean, durable finish –
  Washable, Impact-resistant,
  Scratch-resistant, Soil-resistant
- Ceiling-2-Ceiling™ Post-consumer Recycled Content options: items 1911HRC, 1912HRC, 1914HRC, 1915HRC. 71% Pre-consumer; 15% Post-consumer
- USDA-Certified Biobased Product – 95%
- Available with AirGuard™ coating
- Item 1912 available with Create!™ printed images and patterns
- Non-directional visual reduces scrap and installation time
- Compatible with the TechZone® Ceiling Systems
- 30-Year Limited System Warranty against visible sag (excludes items 1905 and 1929), mold, and mildew
- 10-Year replacement panel available for items 1911, 1912, 1914, 1915

  10-YEAR REPLACEMENT PANEL AVAILABILITY
- Available with factory-cut holes for USAI® trimless downlight fixture integration.

TYPICAL APPLICATIONS

- Offices – closed spaces for privacy and confidentiality; open spaces for focus, collaboration, and teaming
- Healthcare – assists in addressing HIPAA, HCAHPS, and FGI acoustical requirements
- Classrooms
- Corridors
- Lobbies/reception areas
- Department stores/retail

COLOR

White
(WH)

DETAILS (Other Suspension Systems compatible. Refer to listing on next page.)

1. Ultima® Beveled Tegular
2. Ultima® with Suprafine® 9/16" suspension system
3. Ultima® with Silhouette® XL® 9/16" suspension system with 1/4" reveal

TechLine 877 276-7876
armstrongceilings.com/ultima

Armstrong®
World Industries

ULTIMA®
ULTIMA® High NRC

Tegular
fine texture

CLOSED LOOP RECYCLED CONTENT
CEILING-2-CEILING™

USDA CERTIFIED BIOBASED PRODUCT
PRODUCT 95%

Declare.

SUSTAIN®
High Performance
Sustainable Ceiling Systems

GREENGUARD
Gold Certified
(details below)

LEED® | WELL™ | LBC

UP TO 87% RECYCLED CONTENT

Calculate sustainability with Green Genie™
armstrongceilings.com/greengenie

energy management	construction waste mgmt	regional materials	design for flexibility	EPD	recyclable/ extended producer resp.	biobased materials	recycled content	sourcing of raw materials	material ingredient reporting	low emitting/ materials	lighting quality	acoustics
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

▲ LOCATION DEPENDENT

VISUAL SELECTION

PERFORMANCE SELECTION

Dots represent high level of performance.

$$$$

Product (armstrongceilings.com/suspdwgs)	Susp. Dwg.		Item No.	Dimensions (Inches)	UL Classified Acoustics NRC	+ CAC	Total Acoustics[1] = NRC + CAC	Articulation Class	Fire Performance	Light Reflect	Bio-Block Anti-Mold/ Mildew	Humi-Guard+ Sag Resistant	Certified Low VOC Emissions	CleanAssure™ Disinfectable Panels Fog	Wash	DURABILITY Impact	Scratch	Soil	Recycle Program	30-Yr Warranty
ULTIMA® High NRC 15/16" Beveled Tegular	15	new	2081	24 × 24 × 1"	0.85 •	35 •	BEST	170 •	Class A	0.85 •	•	•	•	•	•	•	•	•	•	•
		new	2084	24 × 48 × 1"	0.85 •	35 •	BEST	170 •	Class A	0.85 •	•	•	•	•	•	•	•	•	•	•
HRC items not included in made-to-order panels.			1941	24 × 24 × 7/8"	0.80 •	35 •	BEST	170 •	Class A	0.87 •	•	•	•	•	•	•	•	•	•	•
			1944	24 × 48 × 7/8"	0.80 •	35 •	BEST	170 •	Class A	0.87 •	•	•	•	•	•	•	•	•	•	•
			1433	24 × 60 × 7/8"	0.80 •	35 •	BEST	170 •	Class A	0.87 •	•	•	•	•	•	•	•	•	•	•
			1436	24 × 72 × 7/8"	0.80 •	35 •	BEST	170 •	Class A	0.87 •	•	•	•	•	•	•	•	•	•	•
ULTIMA® High NRC 9/16" Beveled Tegular	29, 44, 48, 52, 56	new	2082	24 × 24 × 1"	0.85 •	35 •	BEST	170 •	Class A	0.85 •	•	•	•	•	•	•	•	•	•	•
		new	2085	24 × 48 × 1"	0.85 •	35 •	BEST	170 •	Class A	0.85 •	•	•	•	•	•	•	•	•	•	•
HRC items not included in made-to-order panels.			1942	24 × 24 × 7/8"	0.80 •	35 •	BEST	170 •	Class A	0.87 •	•	•	•	•	•	•	•	•	•	•
			1942HRC	24 × 24 × 3/4"	0.75 •	35 •	BEST	170 •	Class A	0.87 •	•	•	•	•	•	•	•	•	•	•
			1945	24 × 48 × 7/8"	0.80 •	35 •	BEST	170 •	Class A	0.87 •	•	•	•	•	•	•	•	•	•	•
			1431	30 × 30 × 7/8"	0.80 •	35 •	BEST	170 •	Class A	0.87 •	•	•	•	•	•	•	•	•	•	•
			1434	24 × 60 × 7/8"	0.80 •	35 •	BEST	170 •	Class A	0.87 •	•	•	•	•	•	•	•	•	•	•
			1437	24 × 72 × 7/8"	0.80 •	35 •	BEST	170 •	Class A	0.87 •	•	•	•	•	•	•	•	•	•	•

7/8" & 1" Thick – 15/16" & 9/16" Beveled Tegular

Made-to-Order Sizes	Width (short side)	Length (long side)	NRC	CAC	Total Acoustics	Articulation Class	Fire Performance	Light Reflect	Anti-Mold/ Mildew	Sag Resistant	Certified Low VOC Emissions	Fog	Wash	Impact	Scratch	Soil	Recycle Program	30-Yr Warranty
1 Ctn Min FASTSIZE 3 WEEKS order to ship	4" – 30"	12" – 72"	N/A	N/A	N/A	N/A	Class A	0.87 •	•	•	•	•	•	•	•	•	•	•

Visit the product page online and see "Configure an Item" to verify capabilities. Questions? email Techline@armstrongceilings.com

MORE ITEMS ▶

[1] Total Acoustics® ceiling panels have an ideal combination of sound absorption and sound blocking in one product.
GOOD (NRC 0.60-0.65; CAC 35+) **BETTER** (NRC 0.70-0.75; CAC 35+) **BEST** (NRC 0.80+; CAC 35+)

MINERAL FIBER – Standard

ULTIMA®
ULTIMA® High NRC

Tegular
fine texture

CLOSED LOOP RECYCLED CONTENT
CEILING-2-CEILING

USDA CERTIFIED BIOBASED PRODUCT
PRODUCT 95%

Declare.

SUSTAIN®
High Performance Sustainable Ceiling Systems

GREENGUARD Gold Certified

LEED® | WELL™ | LBC

UP TO 87% RECYCLED CONTENT
armstrongceilings.com/greengenie

energy management	construction waste mgmt	regional materials	design for flexibility	EPD	recyclable/ extended producer resp.	biobased materials	recycled content	sourcing of raw materials	material ingredient reporting	low emitting/ materials	lighting quality	acoustics
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

▲ LOCATION DEPENDENT

MINERAL FIBER – Standard

VISUAL SELECTION

PERFORMANCE SELECTION

Dots represent high level of performance.

$$$$

armstrongceilings.com/suspdwgs	Susp. Dwg.	Item No.	Dimensions (Inches)	UL Classified Acoustics NRC	+ CAC	= NRC + CAC Total Acoustics[1]	Fire Performance	Light Reflect	Bio-Block Anti-Mold/ Mildew	Humi-Guard+ Sag Resistant	Certified Low VOC Emissions	CleanAssure™ Disinfectable Panels Fog	DURABILITY Wash	Impact	Scratch	Soil	Recycle Program	30-Yr Warranty
ULTIMA® 15/16" Beveled Tegular HRC items not included in made-to-order panels.	15	1422	6 × 48 × 3/4"	N/A	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1917	12 × 24 × 3/4"	N/A	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1993	12 × 48 × 3/4"	0.65*	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1994	12 × 60 × 3/4"	0.65*	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1995	12 × 72 × 3/4"	0.65*	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1911 1911HRC	24 × 24 × 3/4" 24 × 24 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1951	24 × 24 × 3/4"	0.60	40 •	GOOD	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1894	24 × 24 × 3/4"	0.60	40 •	GOOD	Fire Guard™	0.88 •	•	•	•	•	•	•	•	•	•	•
		1914 1914HRC	24 × 48 × 3/4" 24 × 48 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1985	24 × 60 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1981	24 × 72 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
9/16" Beveled Tegular HRC items not included in made-to-order panels.	29, 44, 48, 52, 56	1423	6 × 48 × 3/4"	N/A	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1427	6 × 60 × 3/4"	N/A	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1916	12 × 24 × 3/4"	N/A	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1996	12 × 48 × 3/4"	0.65*	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1997	12 × 60 × 3/4"	0.65*	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1998	12 × 72 × 3/4"	0.65*	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1912 1912HRC	24 × 24 × 3/4" 24 × 24 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1952	24 × 24 × 3/4"	0.60	40 •	GOOD	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1895	24 × 24 × 3/4"	0.60	40 •	GOOD	Fire Guard	0.88 •	•	•	•	•	•	•	•	•	•	•
		1915 1915HRC	24 × 48 × 3/4" 24 × 48 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1986	24 × 60 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1982	24 × 72 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•

Red Numbers are Fire Guard items.

[1] Total Acoustics® ceiling panels have an ideal combination of sound absorption and sound blocking in one product.
GOOD (NRC 0.60-0.65; CAC 35+) **BETTER** (NRC 0.70-0.75; CAC 35+) **BEST** (NRC 0.80+; CAC 35+)

* Item not UL tested

ULTIMA®
ULTIMA® High NRC

Tegular
fine texture

CLOSED LOOP RECYCLED CONTENT
CEILING-2-CEILING™

USDA CERTIFIED BIOBASED PRODUCT
PRODUCT 95%

Declare.

SUSTAIN®
High Performance
Sustainable Ceiling Systems

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Gold Certified
(details below)

LEED™ | WELL™ | LBC

UP TO 87% RECYCLED CONTENT

Calculate sustainability with Green Genie™
armstrongceilings.com/greengenie

energy management	construction waste mgmt	regional materials	design for flexibility	EPD	recyclable/ extended producer resp.	biobased materials	recycled content	sourcing of raw materials	material ingredient reporting	low emitting/ materials	lighting quality	acoustics
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

▲ LOCATION DEPENDENT (regional materials)

VISUAL SELECTION

PERFORMANCE SELECTION
Dots represent high level of performance.

$$$$

Description	armstrongceilings. com/suspdwgs Susp. Dwg.	Item No.	Dimensions (Inches)	UL Classified Acoustics NRC	UL Classified Acoustics CAC	Total Acoustics[1] NRC + CAC	Fire Performance	Light Reflect	Bio-Block Anti-Mold/ Mildew	Humi-Guard+ Sag Resistant	Certified Low VOC Emissions	CleanAssure™ Disinfectable Panels Fog	Wash	DURABILITY Impact	Scratch	Soil	Recycle Program	30-Yr Warranty
9/16" Beveled Tegular	29, 44, 48, 52, 56	1905 1905HRC	30 × 30 × 3/4" 30 × 30 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	Std	•	•	•	•	•	•	•	1-Yr
HRC items not included in made-to-order panels.		1929 1929HRC	30 × 54 × 3/4" 30 × 54 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	Std	•	•	•	•	•	•	•	1-Yr
3/4" Thick – 15/16" & 9/16" Beveled Tegular																		
Made-to-Order Sizes 1 Ctn Min FASTSIZE 3 WEEKS order to ship Visit the product page online and see "Configure an Item" to verify capabilities. Questions? email Techline@armstrongceilings.com		Width (short side): 4" – 30"	Length (long side): 12" – 72"	N/A	N/A	N/A	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
ULTIMA® with AirGuard™ Coating 15/16" Beveled Tegular	15	1901	24 × 24 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
		1904	24 × 48 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
9/16" Beveled Tegular	29, 44, 48, 52, 56	1902	24 × 24 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•
AirGuard™ Coating actively removes formaldehyde from indoor air.		1906	24 × 48 × 3/4"	0.75 •	35 •	BETTER	Class A	0.88 •	•	•	•	•	•	•	•	•	•	•

[1] Total Acoustics® ceiling panels have an ideal combination of sound absorption and sound blocking in one product.
GOOD (NRC 0.60-0.65; CAC 35+) **BETTER** (NRC 0.70-0.75; CAC 35+) **BEST** (NRC 0.80+; CAC 35+)

SUSPENSION SYSTEMS

15/16": Prelude®

9/16": Silhouette® 1/4" Reveal; Silhouette 1/8" Reveal; Suprafine®; Interlude® XL® HRC

Blizzard White – Suspension System Finish
A color and texture coordinated suspension system to complement Ultima® ceiling panels for a monolithic look and feel.

PHYSICAL DATA

Material
Wet-formed mineral fiber with DuraBrite® acoustically transparent membrane

Surface Finish
DuraBrite with factory-applied latex paint

Fire Performance
Class A: ASTM E84 and CAN/ULC S102 surface burning characteristics. Flame Spread Index of 25 or less. Smoke Developed Index of 50 or less (UL labeled).

Fire Guard™: A fire-resistive ceiling when used in applicable UL assemblies

ASTM E1264 Classification
Type IV, Form 2, Pattern E; Fire Class A

Humidity/Sag Resistance
HumiGuard® Plus ceiling panels are recommended for areas subject to high humidity, up to, but not including, standing water and outdoor applications. (Excludes items 1905 and 1929).

Anti-Mold/Mildew
Ceiling panels with BioBlock® performance resist the growth of mold and mildew on the tile surface.

VOC Emissions
GREENGUARD Gold Certified
Third-party certified compliant with California Department of Public Health CDPH/EHLB/Standard Method Version 1.2, 2017. This standard is the guideline for low emissions in LEED®, WELL Building Standard™, Living Building Challenge® (LBC), CalGreen Title 24, ANSI/ASHRAE/USGBC/IES Standard 189; ANSI/GBI Green Building Assessment Protocol.

PRODUCT CERTIFIED FOR LOW CHEMICAL EMISSIONS
UL.COM/GG
UL 2818
GREENGUARD
GOLD

Acoustical Performance
CAC testing conducted using Prelude® XL® suspension system for 15/16" edge detail and Silhouette® suspension system for 9/16" edge detail.

Primary (Embodied) Energy
See all LCA information on our EPDs.

High Recycled Content
Contains greater than 50% total recycled content. Total recycled content based on product composition of post-consumer and pre-consumer (post-industrial) recycled content per FTC guidelines. HRC items contain 15% or greater post-consumer recycled ceilings.

Insulation Value
R Factor – 2.2 (BTU units); R Factor – 0.39 (Watts units)
2081, 2081, 2084, 2085 – R Factor – 2.9 (BTU units); 0.445 (Watts units)

Cleaning and Disinfecting
Cleaning and CDC recommended disinfecting options available on armstrongceilings.com/cleaning

30-Year Performance Guarantee & Warranty
When installed with Armstrong® Suspension System. Details at armstrongceilings.com/warranty

Weight; Square Feet/Carton
1945 – 1.14 LBS/SF; 48 SF/CTN
1941, 1942 – 1.125 LBS/SF; 40 SF/CTN
1944, 1942HRC – 1.125 LBS/SF; 48 SF/CTN
1433, 1434 – 1.05 LBS/SF; 60 SF/CTN
1436, 1437 – 1.04 LBS/SF; 72 SF/CTN
2081, 2082 - 1.0 LBS/SF; 40 SF/CTN
2084, 2085 - 1.0 LBS/SF; 48 SF/CTN
1431 – 1.06 LBS/SF; 62.5 SF/CTN
1917, 1993 – 1.05 LBS/SF; 24 SF/CTN
1422, 1423 – 1.08 LBS/SF; 24 SF/CTN
1905, 1905HRC – 1.05 LBS/SF; 62.5 SF/CTN
1911, 1911HRC, 1912, 1912HRC, 1914, 1914HRC, 1915 – 1.05 LBS/SF; 48 SF/CTN
1916, 1996 – 1.05 LBS/SF; 24 SF/CTN
1427 – 1.07 LBS/SF; 24 SF/CTN
1929, 1929HRC – 1.02 LBS/SF; 68 SF/CTN
1895, 1952, 1951 – 1.31 LBS/SF; 48 SF/CTN
1901, 1902, 1904, 1906,
1894 – 1.08 LBS/SF; 48 SF/CTN
1997, 1994 – 1.05 LBS/SF; 30 SF/CTN
1998, 1995 – 1.05 LBS/SF; 36 SF/CTN
1981, 1982 - 1.08 LBS/SF; 72 SF/CTN
1985, 1986 – 1.08 LBS/SF; 80 SF/CTN

Minimum Order Quantity
1 carton

Metric Items Available
1941M, 1944M, 1945M, 1905M, 1912M, 1912MHRC, 1914M, 1915M, 1916M – Metric items are subject to extended lead times and minimum quantities. Contact your representative for more details.

MINERAL FIBER – Standard

TechLine / 1 877 276-7876
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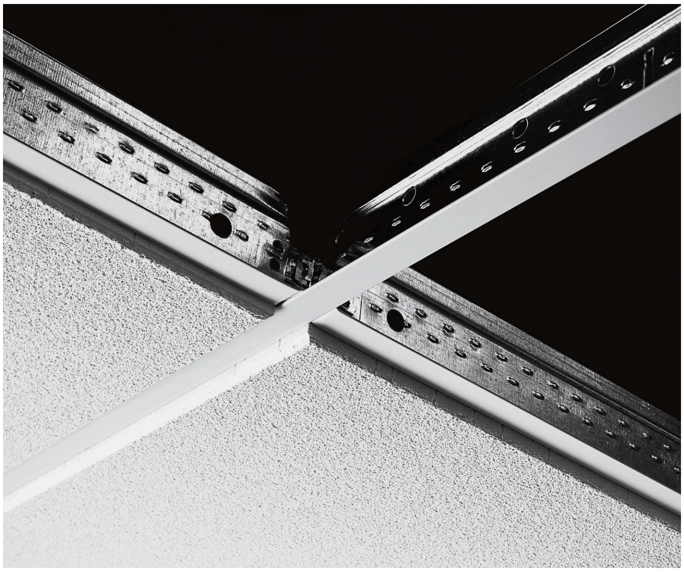
BPCS-3039-1023

Armstrong®
World Industries

SUPRAFINE® XL® & ML
SUPRAFINE XL
High Recycled Content (HRC)
Exposed Tee Suspension System

SUSTAIN™
High Performance
Sustainable
Ceiling Systems



Suprafine XL suspension system

This versatile 9/16" suspension system combines durability and stability with a refined appearance.

KEY SELECTION ATTRIBUTES

- Suprafine® XL® & ML and Suprafine XL HRC are part of the Sustain™ portfolio and meet the most stringent industry sustainability compliance standards today
- **Seismic Rx**® Suspension System saves time and money; Armstrong offers an ICC-ES approach to installations (ESR-1308)
- **PeakForm**® profile increases strength and stability for improved performance during installation
- CleanAssure™ family of products – includes disinfectable panels, suspension systems, and trim (Cleaning and CDC-approved disinfecting options available on armstrongceilings.com/cleaning)
- **SuperLock**™ main beam clip is engineered for a strong, secure connection and fast, accurate alignment confirmed with an audible click; easy to remove/relocate
- Hot-dipped galvanized coating inhibits red rusting better than electrogalvanized or painted systems
- Some items available in metric sizes
- 1-11/16" web height keeps components vertical and stable at light fixture interface
- 10-Year Limited Warranty; 30-Year Limited Ceiling Systems Warranty when used with **HumiGuard® Plus** products
- Made-to-Order main beams and cross tees can be ordered for your project needs in one carton minimums
- Fire Guard™ options offer UL® design fire-rated performance
- Linear lighting integration is easy with made-to-order main-beam-to-cross-tee adapters, rout spacing, miter spacing, and short cross tees (3" to 6" lengths)
- Blizzard White and Charcoal Black powder-coated finish coordinates with Calla®, Optima®, Ultima®, and Lyra® ceiling panels for a clean, seamless, monolithic installed visual

COLORS AND FINISHES
Due to printing limitations, shade may vary from actual product.

Standard

White (WH), Black (BL), Silver Grey (SG), Gun Metal Grey (MY), Silver Satin (SA), Ivory (IV), Medium Taupe (MT), Light Grey (LG), Grey Stone (GS), Custom Colors Available*

new Hay (SHY), new Stone (SE), new Mist (SMT), new Sandstone (SSS), new Fossil (SFL), new Feldspar (SFS), new Boxwood (SBW), new Lilac (SLC), new Rainstorm (SRS), new Oat (SOT)

Premium

Camel (CM), Bronze (BZ)

Powder-Coated Finishes

Blizzard White (ZW), Charcoal Black (ZB)

NOTE: Powder-coated finishes are also available on select Axiom® Classic, Knife Edge®, and Vector® trim profiles

* Colors that are pre-qualified to meet Sustain™ portfolio requirements are available upon request. Other made-to-order colors must be evaluated if sustainability criteria is required. Lead time will increase.
NOTE: 360° paint finishes and custom colors available as special order.

VISUAL SELECTION / PERFORMANCE / PACKAGING

	Item No.◆	Description	Rout Spacing	Dimensions (Inches)	Hanger Spacing* LBS./LFT 4 Ft.	Hanger Spacing* LBS./LFT 5 Ft.	Fire Guard™	Seismic Category	CleanAssure™ Disinfectable Grid: Fog	Spray	Wipe	Pieces/Carton	LFT/Carton
SUPRAFINE® XL® & SUPRAFINE XL High Recycled Content 9/16" (Red Numbers are Fire Guard™ items)	7501_ _ _	12' HD Main Beam	6" O.C.	144 × 9/16 × 1-11/16"	16.86	10.62	N/A	•	•	•	•	20	240
	7501HRC						N/A	•	•	•	•	20	240
	8501						•	•	•	•	•	20	240
	7536		4" O.C.				N/A	•	•	•	•	20	240
	7500_ _❖	12' ID Main Beam	6" O.C.	144 × 9/16 × 1-11/16"	12.75	5.74	N/A	N/A	•	•	•	20	240
	8500						•	N/A	•	•	•	20	240
	7502_ _❖	10' ID Main Beam	6" O.C.	120 × 9/16 × 1-11/16"	12.75	5.74	N/A	N/A	•	•	•	20	200
	XL7580_ _❖	8' Cross Tee	12" O.C.	96 × 9/16 × 1-11/16"	12.73★★	N/A	N/A	•	•	•	•	20	160
	XL7590_ _❖	6' Cross Tee	12" O.C.	72 × 9/16 × 1-11/16"	12.73★★	N/A	N/A	•	•	•	•	20	120
	XL7558_ _❖	5' Cross Tee	6", 20", 30" O.C.	60 × 9/16 × 1-11/16"	N/A	5.80	N/A	•	•	•	•	60	300

★★ Wire at 4'
◆ When specifying or ordering items with a color or finish, add the two- or three-letter suffix to the end of the item number (e.g. 7501 L G _ – Light Grey)
❖ Available in White (WH), and Blizzard White and Charcoal Black powder-coated finishes only
NOTE: Additional Suprafine XL items for TechZone® Integrated Ceiling Systems are listed in the TechZone Technical Guide (BPCS-4486). Available online at armstrongceilings.com/techzone

Dots represent high level of performance.

ASTM Class
HD - Heavy-duty
ID - Intermediate-duty
LD - Light-duty

TechLine 877 276-7876
armstrongceilings.com/suprafine

Armstrong® World Industries

SUPRAFINE® XL® & ML
SUPRAFINE XL
High Recycled Content (HRC)

Exposed Tee Suspension System

SUSTAIN™
High Performance
Sustainable Ceiling Systems

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UP TO 63% RECYCLED CONTENT

Calculate sustainability with Green Genie™
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energy management	construction waste mgmt	regional materials	design for flexibility	EPD	recyclable/ extended producer resp.	biobased materials	recycled content	sourcing of raw materials	material ingredient reporting	low emitting/ materials	lighting quality	acoustics
	✔	✔					✔					

▲ LOCATION DEPENDENT

VISUAL SELECTION | PERFORMANCE | PACKAGING

	Item No.◆	Description	Rout Spacing	Dimensions (Inches)	HANGER SPACING* LBS./LFT 4 Ft.	5 Ft.	Fire Guard™	Seismic Category	CleanAssure™ Disinfectable Grid Fog	Spray	Wipe	Pieces/ Carton	LFT/ Carton
SUPRAFINE® XL® & SUPRAFINE XL High Recycled Content 9/16" (Red Numbers are Fire Guard™ items)	XL7541HRC	4' Cross Tee	12" O.C.	48 × 9/16 × 1-11/16"	12.73	N/A	N/A	•	•	•	•	60	240
	XL7540_ _ _	4' Cross Tee	12" O.C.	48 × 9/16 × 1-11/16"	10.34	N/A	N/A	•	•	•	•	60	240
	XL8540						•	•	•	•	•	60	240
	XL7549_ _❖	4' Cross Tee	12" O.C.	48 × 9/16 × 1-11/16"	16.42	N/A	N/A	•	•	•	•	60	240
	XL7530_ _❖	3' Cross Tee	N/A	36 × 9/16 × 1-11/16"	N/A	N/A	N/A	•	•	•	•	60	180
	XL7570_ _❖	30" Cross Tee	N/A	30 × 9/16 × 1-11/16"	28.67	N/A	N/A	•	•	•	•	60	150
	XL7520_ _ _	2' Cross Tee	N/A	24 × 9/16 × 1-11/16"	51.83	N/A	N/A	•	•	•	•	60	120
	XL7520HRC						N/A	•	•	•	•	60	120
	XL8520						•	•	•	•	•	60	120
	XL7510_ _❖	1' Cross Tee	N/A	12 × 9/16 × 1-11/16"	51.83	N/A	N/A	•	•	•	•	120	120
		9/16" Suprafine XL & Suprafine XL High Recycled Content											
Size Capabilities NOTE: Up to 6 weeks for color and size combinations. 1 Ctn Min FASTSIZE 2 WEEKS order to ship		Main Beam Length 36" – 144" Rout spacing 3" from ends, 4" thereafter	Cross Tee Length 3" – 144"	N/A	N/A	N/A	N/A	•	•	•	•	Varies	Varies
SUPRAFINE® XL® items for TechZone® Ceiling Systems 9/16" Additional items available in TechZone Technical Guide – BPCS-4486 or armstrongceilings.com/techzone	7504_ _❖	120" HD Main Beam	15", 42", 48", 75", 102", 108" O.C.	120 x 9/16 x 1-11/16"	12.75	10.62	N/A	•	•	•	•	20	200
	7505_ _❖	100" HD Main Beam	2", 26", 50", 74", 98" O.C.	100 x 9/16 x 1-11/16"	N/A	N/A	N/A	•	•	•	•	20	166
	7507_ _❖	144" HD Main Beam	15", 36", 42", 63", 84", 90", 11",132", 138" O.C.	144 x 9/16 x 1-11/16"	N/A	N/A	N/A	•	•	•	•	20	240
	7508_ _❖	132" HD Main Beam	10", 30", 50", 56", 76", 96", 116", 122" O.C.	132 × 9/16 × 1-11/16"	N/A	N/A	N/A	•	•	•	•	20	220
	TZXL7556_ _†	56" Cross Tee	N/A	56 x 9/16 x 1-11/16"	N/A	N/A	N/A	•	•	•	•	60	280
	XL7562_ _❖	42" Cross Tee	N/A	42 x 9/16 x 1-11/16"	12.34	N/A	N/A	•	•	•	•	60	210
	XL7528_ _❖	28" Cross Tee	N/A	28 x 9/16 x 1-11/16"	N/A	N/A	N/A	•	•	•	•	60	140
	XL7561_ _❖	21" Cross Tee	N/A	21 x 9/16 x 1-11/16"	N/A	N/A	N/A	•	•	•	•	60	105
	XL7506_ _❖	6" Cross Tee	N/A	6 x 9/16 x 1-11/16"	N/A	N/A	N/A	•	•	•	•	60	30
	XL7504_ _❖	4" Cross Tee	N/A	4 x 9/16 x 1-11/16"	N/A	N/A	N/A	•	•	•	•	60	20
SUPRAFINE ML 9/16"	ML7540_ _❖	4' Cross Tee	N/A	48 x 9/16 x 1-11/16"	10.34	N/A	N/A	N/A	•	•	•	60	240
	ML7520_ _❖	2' Cross Tee	N/A	24 x 9/16 x 1-11/16"	51.80	N/A	N/A	N/A	•	•	•	60	120

* Simple Span
** Wire at 4'
◆ When specifying or ordering items with a color or finish, add the two- or three-letter suffix to the end of the item number (e.g. XL7540 L G _ – Light Grey)
❖ Available in White (WH), and Blizzard White (ZW) and Charcoal Black (ZB) powder-coated finishes only
† Available in Black (BL), Silver Grey (SG), and Gun Metal Grey (MY) only
NOTE: Additional Suprafine XL items for TechZone Integrated Ceiling Systems are listed in the TechZone Technical Guide (BPCS-4486). Available online at armstrongceilings.com/techzone

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SUSPENSION SYSTEMS – Standard

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energy management	construction waste mgmt	regional materials	design for flexibility	EPD	recyclable/ extended producer resp.	biobased materials	recycled content	sourcing of raw materials	material ingredient reporting	low emitting/ materials	lighting quality	acoustics
	✓	✓					✓					

▲ LOCATION DEPENDENT

VISUAL SELECTION | PERFORMANCE | PACKAGING

	Item No.◆	Description	Rout Spacing	Dimensions (Inches)	HANGER SPACING* LBS./LFT 4 Ft.	5 Ft.	Fire Guard™	Seismic Category	CleanAssure™ Disinfectable Grid Fog	Spray	Wipe	Pieces/ Carton	LFT/ Carton
SUPRAFINE XL 360° Painted Grid to match Axiom® Trim 9/16"	AX75013_ _ _	12' ID Main Beam, Routs 6" O.C.	N/A	144 × 9/16 × 1-11/16"	16.86	10.62	N/A	N/A	•	•	•	20	240
	AX75203_ _ _	2' Cross Tee	N/A	24 × 9/16 × 1-11/16"	51.83	N/A	N/A	N/A	•	•	•	60	120
	AX75403_ _ _	4' Cross Tee	N/A	48 × 9/16 × 1-11/16"	10.34	N/A	N/A	N/A	•	•	•	60	240

* Simple Span
◆ When specifying or ordering items with a color or finish, add the two- or three-letter suffix to the end of the item number (e.g. AX75003 L G _ – Light Grey)

Dots represent high level of performance.

ASTM Class
HD - Heavy-duty
ID - Intermediate-duty
LD - Light-duty

VISUAL SELECTION | PACKAGING

	Item No.◆	Description	Length	(A) Flange	(B) Flange	(C) Reveal	(D) Reveal	Pieces/ Carton	LFT/ Carton
Suggested Wall Moldings and Shadow Moldings (Additional molding options available)	7808_ _††	10' Hemmed Angle Molding	120"	2"	2"	N/A	N/A	10	100
	7804_ _ _ 7804HRC	12' Hemmed Angle Molding	144"	9/16"	7/8"	N/A	N/A	30	360
	7800_ _ _† 7800HRC	12' Hemmed Angle Molding	144"	7/8"	7/8"	N/A	N/A	30	360
	7835	10' Channel Molding	120"	7/8"	1-3/4"	3/8"	N/A	20	200
	7873_ _❖	10' Shadow Molding	120"	9/16"	15/16"	3/8"	N/A	30	300
	7874_ _❖	10' Shadow Molding	120"	9/16"	15/16"	1/4"	N/A	30	300
	7878_ _ _**†	10' Seismic Shadow Molding	120"	15/16"	15/16"	3/8"	N/A	30	300
	7889_ _❖	10' Shadow Molding	120"	9/16"	15/16"	3/8"	1/4"	30	300
	7850_ _❖	12' Hemmed Angle Molding	144"	1-1/8"	7/8"	N/A	N/A	30	360

** Suitable for IBC Category D,E,F installations using Armstrong® Seismic Rx® suspension system and BERC2 Clip
◆ When specifying or ordering items with a color or finish, add the two- or three-letter suffix to the end of the item number (e.g., 7808 L G _ – Light Grey)
❖ Available in White (WH), and Blizzard White (ZW) and Charcoal Black (ZB) powder-coated finishes only
† Not available in Silver Grey (SG), Gun Metal Grey (MY), or Silver Satin (SA).
†† Available in White (WH), Silver Grey (SG), Silver Satin (SA), and Blizzard White (ZW) and Charcoal Black (ZB) powder-coated finishes only

MAXIMUM FIXTURE WEIGHT

Drawing Key: Main beam (↑) Cross tee (---) Hanger wire (+)

	Configuration A	Configuration B	Item No.	Fixture A	Fixture B	Planning Module A	Planning Module B	Hanger Spacing A	Hanger Spacing B	Maximum Weight A	Maximum Weight B
Main Beam to Main Beam			8500/7500/7502 7501	24" x 48" 24" x 48"	24" x 48" 24" x 48"	48" x 48" 48" x 48"	48" x 48" 48" x 48"	48" 48"	48" 48"	73.36 lbs. 100 lbs.	57.07 lbs. 70.8 lbs.
			7500/7502 7501	12" x 48" 12" x 48"	12" x 48" 12" x 48"	48" x 48" 48" x 48"	48" x 48" 48" x 48"	48" 48"	48" 48"	68 lbs. 85 lbs.	44 lbs. 61 lbs.

Main beams tested as follows: 7500 tested at 12.7 lbs./lin. ft. to 1/360 of 4' span; 7501 tested at 16.86 lbs./lin. ft. to 1/360 of 4' span; 8500 tested at 13.3 lbs./lin. ft. to 1/360 of 4' span. 48" cross tee tested at 10.34 lbs./lin. ft. to 1/360 of 4' span.

	Configuration A	Configuration B	Item No.	Fixture A	Fixture B	Planning Module A	Planning Module B	Hanger Spacing A	Hanger Spacing B	Maximum Weight A	Maximum Weight B
Cross Tee to Cross Tee			XL7540 XL7541 ML7540	24" x 48" 24" x 48" 24" x 48"	24" x 24" 24" x 24" 24" x 24"	48" x 48" 48" x 48" 48" x 48"	48" x 48" 48" x 48" 48" x 48"	48" 48"	48" 48"	55 lbs. 73 lbs. 65.71 lbs.	67 lbs. 84 lbs. 76 lbs.
			ML7540 XL7541	24" x 48" 24" x 48"	12" x 48" 12" x 48"	48" x 48" 48" x 48"	48" x 48" 48" x 48"	48" 48"	48" 48"	46 lbs. 52 lbs.	– –

Cross tees tested as follows: 48" cross tee tested at 10.34 lbs./lin. ft. to 1/360 of 4' span.
Fixtures weighing more than 56 lbs. should be independently supported. Light fixture clips are required at all fixture locations.
Fixture weight is based on single fixture only. For end-to-end fixtures or other configurations not shown, consult your Armstrong representative.
NOTE: The above data is based on 48" hanger wire spacing, board weight of 1 lb./sq. ft., maximum deflection of tees not to exceed 1/360 of the span, and suspension system installed in accordance with ASTM C636. To derive maximum lbs/sf, divide the O.C. spacing of the component into the lbs/lf given in the load test data table.

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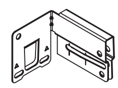
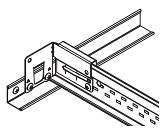
energy management | construction waste mgmt ✔ | regional materials ✔ | design for flexibility | EPD | recyclable/ extended producer resp. | biobased materials | recycled content ✔ | sourcing of raw materials | material ingredient reporting | low emitting/ materials | lighting quality | acoustics

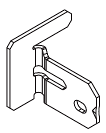
▲ LOCATION DEPENDENT

ACCESSORIES

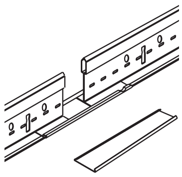
Item No.	Description	Pieces/ Carton
BERC2	2" Beam End Retaining Clip Allows you to create a code compliant Seismic D, E, F ceiling installation while eliminating the need to use 2" wall molding or spreader bars.	
BERC2	Steel	200
FZBERC2	Steel	50
ALBERC2	Aluminum	200
FZALBERC2	Aluminum	50
STAC	Single Tee Adapter Clip Used to create code compliant non-seismic and seismic C and D, E, F off-module main beam to cross tee connections.	
STAC		100
FZSTAC		50

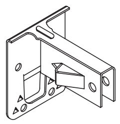




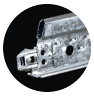


Item No.	Description	Pieces/ Carton
ES49	Expansion Sleeves For 9/16" Suprafine	
ES49		200
FZES49		50
GCWA	Grip Clip Wall Attachment Joins main beam or cross tee to wall molding via locking barbs without pop rivets or screws.	
GCWA		200
FZGCWA		50

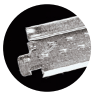




DETAILS

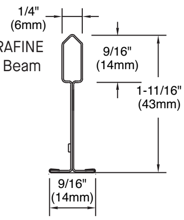


SUPRAFINE® XL® Cross Tee

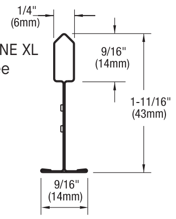


SUPRAFINE ML Cross Tee

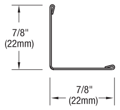
SUPRAFINE Main Beam



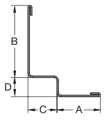
SUPRAFINE XL Cross Tee



7/8" Hemmed Angle Molding



Shadow Molding



SEISMIC PERFORMANCE

Main Beams
7501, 7501HRC, 7504, 7505, 7507, 7536, 8501
Minimum Lbs. To Pull Out Compression/Tension
335.0

Cross Tees
XL7558, XL7540, XL7549, XL7520, XL7510, XL8520, XL7570, XL7590, XL7580, XL8540, XL7541,753032, 752032, ML7540, ML7520

Minimum Lbs. To Pull Out Compression/Tension
352.0, 130.0

ICC Reports
For areas under ICC jurisdiction, see ICC evaluation report number ESR-1308 for allowable values and/or conditions of use concerning the suspension system components listed on this page. The report is subject to reexamination, revisions, and possible cancellation.

PHYSICAL DATA

Material
Hot dipped galvanized steel

Surface Finish
Baked polyester paint or powder coated

Manufactured and tested in accordance with ASTM C635

Face Dimension
9/16"

Profile
Exposed tee

Design Considerations
Physical product samples for standard and custom colors are available upon request. Please refer to the physical product sample prior to making a final selection. While we strive to ensure exact color matches, various factors such as differences in materials, texture, substrate porosity, painting processes, lighting, and observer subjectivity can all affect how paint colors appear on ceiling and wall panels, suspension systems, and trim products. Due to these and other differences, ceiling and wall panels, trim products, and suspension systems with the same color name will coordinate but may not be an exact color match. Product is dye-lotted. Order sufficient initial quantities and attic stock to minimize possible color variation.

Cross Tee/Main Beam Interface
XL – Override
ML – Flush fit

End Detail
Main Beam: Staked-on clip
XL Cross Tee: Staked-on clip
ML Cross Tee: Staked-on hook clip

Duty Classification
Intermediate or Heavy-duty

Cleaning & Disinfecting
Cleaning and CDC approved disinfecting options available on armstrongceilings.com/cleaning

SUSPENSION SYSTEMS – Standard

Armstrong® World Industries

Rockfon®

Part of ROCKWOOL Group

Rockfon® Tropic®

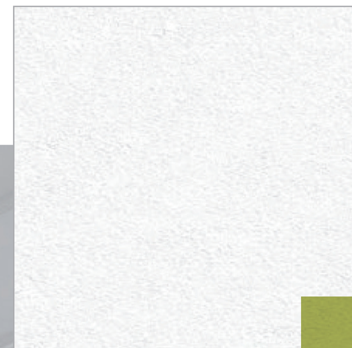
UP TO 0.90 NRC

Features & Benefits

- Smooth white surface
- Good sound absorption (NRC = 0.85 - 0.90)
- High fire performance
- High light reflectance (LR = 0.86)
- Available in square lay-in and tegular
- Fire Performance - Class A

Applications

- Office
- Classroom
- Reception
- Retail
- Hospitality



mindful MATERIALS

UL GREENGUARD
PRODUCT CERTIFIED FOR LOW CHEMICAL EMISSIONS
UL.COM/GG
UL 2818
GOLD

Rockfon ceiling tiles are manufactured using advanced stone wool technology. All stone wool tiles benefit from:

High Acoustic Absorption

Fire Performance - Class A

Moisture and Sag Resistance

Smooth, Modern Aesthetics

Rockfon® Tropic®

LEED® v4.1 Highlights

Materials and Resources (MR)

Waste Management Planning	–
Interiors Life Cycle Impact Reduction	✓
Environmental Product Declarations	✓
Sourcing of Raw Materials	✓
Material Ingredients	✓
Waste Management	–

Indoor Environmental Quality (EQ)

Low-Emitting Materials	✓
Interior Lighting	✓
Acoustic Performance	✓

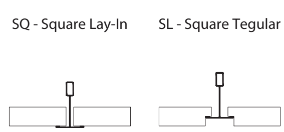
Recycled Content: 45%

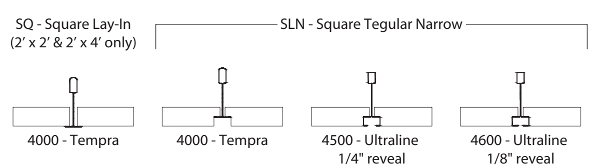
Standard Panels

Edge Designation		Item Number	Modular Size (nominal)	NRC	AC	Fire Class	Light Reflectance	Sag Resistance (relative humidity)	Low VOC	Packaging Information lbs/ sqft	Packaging Information sqft/ carton
Square Lay-In	SQ	1000	2′ x 2′ x 5/8″	0.85	-	A	0.86	up to 100%	✓	0.38	112
	SQ	1001	2′ x 4′ x 5/8″	0.85	-	A	0.86	up to 100%	✓	0.38	112
	SQ	1009	20″ x 60″ x 3/4″	0.90	-	A	0.86	up to 100%	✓	0.45	83.33
Square Tegular Narrow	SLN	1020	2′ x 2′ x 5/8″	0.85	-	A	0.86	up to 100%	✓	0.47	56
	SLN	1021	2′ x 4′ x 5/8″	0.85	-	A	0.86	up to 100%	✓	0.47	112
Square Tegular	SL	1060	2′ x 2′ x 5/8″	0.85	-	A	0.86	up to 100%	✓	0.47	56
	SL	1061	2′ x 4′ x 5/8″	0.85	-	A	0.86	up to 100%	✓	0.47	112

**Refer to the Rockfon® Module System brochure for module tile sizes.*

15/16″ Suspension Systems	9/16″ Suspension Systems
200, 1200 and Fire Rated systems	4000, 4500, 4600 and Fire Rated systems





Recycled content values for our stone wool tiles and panels are based on 2021 production averages of a standard 2′ X 2′ tile, and based on their primary production location.

Rockfon® Tropic® Properties

Material

Stone wool (Mineral Wool) ceiling tiles with factory applied latex paint on glass scrim surface
ASTM E1264 CLASSIFICATION: Type XX - Stone wool base with membrane-faced overlay, Pattern G

Fire Performance

Surface burning characteristics:
UL723 (ASTM E84) Flame Spread Index: 0
Smoke Developed Index (UL Labeled): 5
CAN/ULC S102 Flame Spread Index: 5
Smoke Developed Index: 0

Sustainability

Many of Rockfon stone wool acoustic solutions are GREENGUARD Gold low VOC certified and meet the State of California's Department of Public Health Services Standard Practice for Specification Section 01350 (California Section 01350) for testing chemical emissions.

Selected potential applications: LEED, WELL, CHPS, Green Globes, BREEAM Int. and CALGreen

✓ GREENGUARD Gold available*
✓ Environmental Product Declaration available*
✓ Health Product Declaration available*
✓ Declare Label available*

* Applicable to all edge types

Environment

45% recycled content. Recycled content based on U.S. manufacturing.

Warranty

30-Year Limited Product Warranty
See rockfon.com

Thermal Insulation

R Value (BTU Units): 2.2 - 2.6
RSI Value (Watts Units): 0.39 - 0.46

Hygiene

Stone wool provides no sustenance to microorganisms

Cleaning

Vacuum

Tile Directionality

Rockfon Tropic® tiles are directional and must be installed according to backside arrow direction. The arrow can be turned 180°, not 90°.

GREENGUARD Gold Certified for Office and Educational Environments

CERTIFIED Environmental Product Declaration

060523

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cs@rockfon.com
rockfon.com

Rockfon®

Part of ROCKWOOL Group

Chicago Metallic® 1200 15/16"
Chicago Metallic® 1250 Fire-Rated 15/16"

Features and Benefits

- Acoustical grid systems come in Intermediate and Heavy Duty designs with stab-end cross tees
- Stab cross tees protect against lateral pull out. Compliant with worldwide seismic requirements, including IBC.
- Suitable for Seismic Design Categories A-F
- Fire-rated grid components are designed with expansion reliefs, making it suitable for fire-rated ceiling assemblies
- System available in (1200) non-fire rated, (1250) fire-rated, and in (1200HRC) high recycled content
- Chicago Metallic suspension systems meet Class-A flame spread rating in accordance with ASTM standard E84

Applications

- Offices
- Retail
- Classrooms
- Education
- Healthcare
- General Interiors

Acoustical Ceiling Suspension System

Chicago Metallic® 1250 Fire-Rated 15/16"

Chicago Metallic® 1200 15/16"

Chicago Metallic® 1250 Fire-Rated 15/16"

LEED® v4.1 Highlights

Materials and Resources (MR)

Waste Management Planning	✓
Interiors Life Cycle Impact Reduction	✓
Environmental Product Declarations	✓
Sourcing of Raw Materials	✓
Material Ingredients	-
Waste Management	✓

Indoor Environmental Quality (EQ)

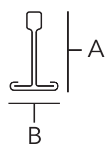
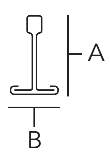
Low-Emitting Materials	✓
Interior Lighting	✓
Acoustic Performance	✓

Recycled Content 30%
HRC Products 65%

Performance Properties:

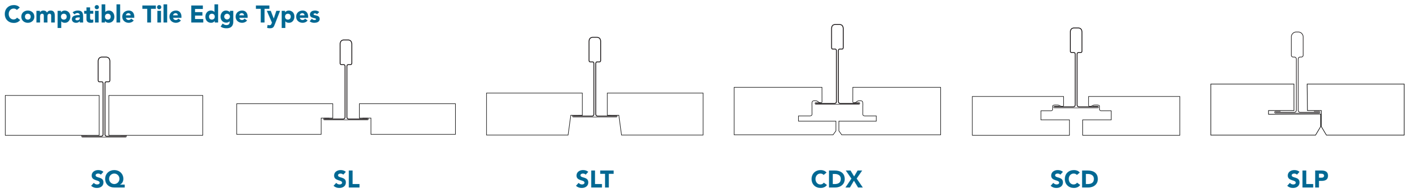
Base Material	Hot-Dip Galvanized Steel (HDG-30)
Capping Material / Finish	Hot-Dip Galvanized Steel (HDG-30) / Baked Polyester Enamel
End Details	**Main Runners:** Non-Directional Bayonet Coupling **Cross Tees:** Stab-End
Structural Classification	Intermediate and Heavy Duty per ASTM C635
Flame Spread Rating	Class A per ASTM E84
Warranty	40-Year Suspension System Warranty
Recycled Content	30%, HRC Products 65%

Main Runners/Cross Tees

Detail	Product Number	Length x Height (A) x Face (B)	Slotting	Structural Classification (ASTM C635)	Fire-Rated	Seismic	Packaging			Palletization	
							Pcs/ Ctn	LF/ Ctn	Lbs/ Ctn	Ctn/ Pallet	Lbs/ Pallet
Main Runners											
 A B	216.01H	120" x 1-41/64" x 15/16"	6" OC	ID	-	A-C	20	200	63	28	1764
	299.01H	120" x 1-41/64" x 15/16"	10" OC	ID	✓	A-C	20	200	63	28	1764
	200.XXZ.01	144" x 1-41/64" x 15/16"	6" OC	HD	-	A-F	20	240	71.2	30	2136
	200.XXZ.01HRC	144" x 1-41/64" x 15/16"	6" OC	HD	-	A-F	20	240	71.2	30	2136
	211.01Z	144" x 1-41/64" x 15/16"	6" OC	ID	-	A-C	20	240	52	30	1560
	250.01Z	144" x 1-41/64" x 15/16"	6" OC	ID	✓	A-C	20	240	52	30	1560
	270.XXZ.01	144" x 1-41/64" x 15/16"	6" OC	HD	✓	A-F	20	240	73	30	2190
Cross Tees											
 A B	1211.01Z	4" x 1-1/2" x 15/16"	No Slots	-	-	A-F	60	20	5	10	50
	1212.01Z	6" x 1-1/2" x 15/16"	No Slots	-	-	A-F	60	30	5	10	50
	1251.01H	12" x 1-1/2" x 15/16"	No Slots	-	✓	A-F	100	100	23	50	1150
	1257.01Z	20" x 1-1/2" x 15/16"	No Slots	-	✓	A-F	60	100	24	64	1536
	1252.01HRCZ	24" x 1-1/2" x 15/16"	No Slots	-	-	A-F	75	150	24	50	1200
	1202.01Z	24" x 1-5/16" x 15/16"	No Slots	-	-	A-F	60	120	20	64	1280
	1252.01Z	24" x 1-1/2" x 15/16"	No Slots	-	✓	A-F	60	120	28	64	1792
	1258.01H	30" x 1-1/2" x 15/16"	No Slots	-	✓	A-F	50	125	29	42	1218
	1253.01H	36" x 1-1/2" x 15/16"	12" OC	-	✓	A-F	50	150	36	42	1512
	1210.01Z	48"x 1-1/2" x 15/16"	12" OC	-	-	A-F	60	240	42	30	1260
	1214.01Z	48" x 1-1/2" x 15/16"	12" OC	-	-	A-F	60	240	52.8	30	1584
	1254.01Z	48" x 1-1/2" x 15/16"	12" OC	-	✓	A-F	60	240	52.8	30	1584
	1274.01Z	48" x 1-1/2" x 15/16"	12" OC	-	✓	A-F	60	240	73.2	30	2196
	1214.01HRCZ	48" x 1-1/2" x 15/16"	12" OC	-	-	A-F	50	200	61	40	2440
	1207.01H	60" x 1-1/2" x 15/16"	6" OC	-	-	A-F	50	250	73	30	2190
	1296.01H	60" x 1-1/2" x 15/16"	5 Slots: Midpoint, 10" Each Side of Midpoint, and 6" from Each End	-	✓	A-F	50	250	57	30	1710
	1236.01H	72" x 1-1/2" x 15/16"	12" OC	-	-	A-F	25	150	37	28	1036
	1278.01H	96" x 1-1/2" x 15/16"	12" OC	-	-	A-F	25	200	46	28	1288

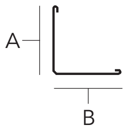
Custom slotting available. Contact Rockfon Customer Service for details and service levels.

Compatible Tile Edge Types



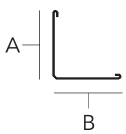
Perimeter Components

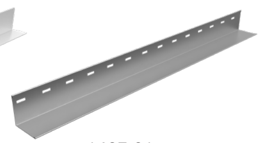
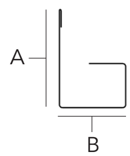
Wall Angles

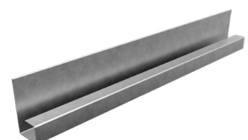


Product Number	Length, Height (A) x Face (B)	Packaging			Palletization	
		Pcs/Ctn	LF/Ctn	Lbs/Ctn	Ctn/Pallet	Lbs/Pallet
1420.01	144", 15/16" x 15/16"	42	504	69	30	2070
21420.01	144", 15/16" x 15/16"	25	300	41	40	1640
1420.01HRC	144", 15/16" x 15/16"	42	504	39	30	1170
1480.01HRC	144", 9/16" x 15/16"	25	300	69	30	2070
1480.01	144", 9/16" x 15/16"	25	300	39	30	1170
1430.01	144", 7/8" x 7/8"	30	360	52	40	2080
1425.01	144", 2" x 2"	20	240	82	28	2296
1428.01	144", 1" x 2"	20	240	54	40	2160

Specialty Wall Angles

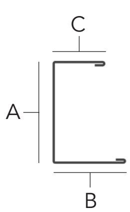



1485.01

1427.01



1454.01

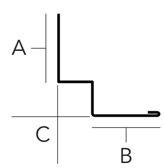
Product Number	Length, Height (A) x Face (B)	Packaging			Palletization	
		Pcs/Ctn	LF/Ctn	Lbs/Ctn	Ctn/Pallet	Lbs/Pallet
1485.01	96", 1-1/8" x 7/8" Flexible Wall Angle (White)	63	504	29	Palletized to Order	Palletized to Order
1427.01	144", 15/16" x 15/16" Pre-punched Angle (White)	42	504	74	30	2220
1454.01	120", 1-4.75/8" x 15/16" Concealed Box Wall Angle	20	200	67	32	2144

Wall Channels



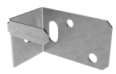
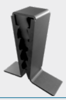
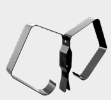
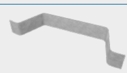
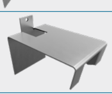
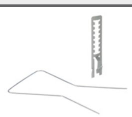
Product Number	Length, Height x Face x Top Flange (Length, A x B x C)	Packaging			Palletization	
		Pcs/ Ctn	LF/ Ctn	Lbs/ Ctn	Ctn/ Pallet	Lbs/ Pallet
1448.01	120", 1-9/16" x 15/16"x 3/4"	30	300	74	18	1332
1449.01	120", 1-15/16" x 15/16" x 15/16"	24	240	62	18	1116

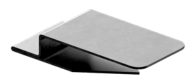
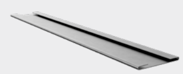
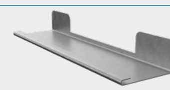
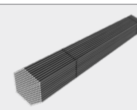
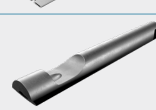
Shadow Moldings



Product Number	Length, Height x Face x Reveal (Length, A x B x C x C)	Packaging			Palletization	
		Pcs/ Ctn	LF/ Ctn	Lbs/ Ctn	Ctn/ Pallet	Lbs/ Pallet
1460.01	120", 3/4"x 3/4"x 3/8" x 3/8"	40	400	64	32	2048
1461.01	120", 3/4" x 3/4" x 3/4" x 3/4"	40	400	90	28	2520
1468.01	120", 15/16"x 15/16" x 3/8" x 3/8"	40	400	81	28	2268
1464.905	120", 15/16"x 15/16" x 1/4" x 1/4"	40	400	63	28	1764
1469.01	120", 15/16" x 9/16" x 3/8" x 3/8"	40	400	77	Palletized to Order	Palletized to Order
1466.01	144", 1-3/4" x 1-1/4" x 3/4" x 1/4"	20	240	61	20	1220

Accessories

	Detail	Rockfon Part Number	Product Number	Product Description	Packaging Pcs/ Ctn	Packaging Lbs/ Ctn
Seismic Clips		250374	1496.00	Seismic Perimeter Clip	100	10
		250372	1493.00	Unopposed Tee Clip	100	2
		250373	1494.00	Seismic Separation Clip	100	10
General Clips		250348	935.00	Universal Hold Down Clip	1000	16
		252923	425.01	Hold Down Clip for 5/8" Board 250/1250 Systems	200	2
		250343	820.00	Hold Down Clip for 5/8" Board 250/1250 Systems	1000	7
		237949	490.00	Hold Down Clip for 0"- 3/4" Panels (Black)	100	2
		237952	491.00	Hold Down Clip for 3/4" - 1-1/4" Panels (Blue)	150	2
		237954	492.00	Hold Down Clip for 1-1/2" Panels (Grey)	100	2
		250324	426.01	Butterfly Retention Clip for 0" - 1'' Panels	200	15
		250325	427.01	Butterfly Retention Clip for 1" - 2'' Panels	150	15
		254302	88.00	Border Spring Clip	1000	17
		253183	479.00	90-degree Corner Clip	25	5
		251952	1499.00	Perimeter Grid Clip	100	4
		250321	410.00	Transfer Load Clip, 15/16" Grid (Used to suspend decorative ceilings under acoustical ceilings)	500	28
Facett Panel Clip		260623	495.00	Facett™ Hold Down Clip Kit for 2" – 4" Panels	100	2
Shiplap Clip		250337	477.00	48" SLP Spline, for use with Rockfon Sonar 4x4 SLP	1	1
Spacer Bars		294621	826.00H	2' Spacer Bar for rectangular bulb components	40	15
		294623	828.00H	4' Spacer Bar for rectangular bulb components	40	29
		294619	824.00H	4' Spacer bar notched 2'. For rectangular bulb components.	40	29

	Detail	Rockfon Part Number	Product Number	Product Description	Packaging Pcs/ Ctn	Packaging Lbs/ Ctn
CDX Tiles Accessories		237264	-	CDX Perimeter Spring	100	1.1
		250338	478.00	Concealed Perimeter Clip	50	4.5
		314292	472.00	CDX/SCD Border Clip	100	1.1
		250334	474.01	24" Pre-mitered Vinyl Trim Kit for CDX and SCD only	50	1.4
		250335	475.01	24" Pre-mitered Vinyl Trim Kit for CDX and SCD only	50	2
		250336	476.01	120" Vinyl Trim Piece Straight Cut	1	1
Main Tee Adapters		249858	1288.01H	15/16" Grid Adapter, 9"Length. Bayonet Coupling on One End, Stab on Other End	50	10
Variable Placement Tee		250216	816.01H	2' Cross Tee for 15/16" Grid, Supports Panels Only	40	21
		250217	817.01H	4' Cross Tee for 15/16" Grid, Supports Panels Only	40	40
Suspension System Covers		258677	1320.01	Cover Sleeve for 15/16" Grid	100	10
		251956	839.01	Expansion Coupling Cover	50	1
Corner Caps		Outside/Inside Corner Caps – Refer to Rockfon Grid and Tile Accessories Datasheet for options				
Hanger Wire		250590	96CTL144	Hanger Wire 12' x 12-Gauge	Bundle	50
Grid Paint		250350	940.01	12 oz. Grid Spray Can - White	1	1
		250351 & 250352	940.08 & 940.44	12 oz. Grid Spray Can - Black & Satin Silver	1	1
Tools		250349	937.00	Cross Tee Slotter	1	3
		250353	943.00	Cross Tee Removal Tool	1	1
		250354	944.00	Wire Tie Tool	1	1

Grid Colors

Standard Colors:

01 White	08 Black	44 Satin Silver

Premium Colors:

Color-All	RAL COLOURS	Custom (Color Match)

Metalwood® Solid Coordinating Colors:

401 Maple*	402 Oak*	403 Cherry*	404 Pumpkin Maple*	405 Karri*	406 Walnut*

Woodscenes® Painted Finishes†:

800 Lazy Maple	801 Aged Teak	803 Burnished Cherry	804 Sleek Cherry	805 Weathered Oak	806 Barnwood Grey

** Coordinating solid color to match Metalwood Woodgrain Finishes.*

† Woodscenes Woodgrain Painted Finishes are a decorative powder coat finish that replicate real wood; variations in color and pattern will occur.

Colors shown are reproduced as close as possible to actual product color within the limitations of printing technology. Color chips are available upon request and should be reviewed before making a final selection. Variations in color matches of system components to ceiling panels can result from slight differences in texture, room lighting, painting process and subjectivity of observers.

Performance

Main Runner Allowable Load Test Data Based on 1/360 Span Deflection (Lb/Ft*)

Main Runner	Length	Fire-Rated	Hanger Spacing		
			ASTM C635 - 4'	5'	6'
216.01H	120"	-	ID	6.3	3.9
299.01H	120"	✓	ID	6.3	3.9
200.XXZ.01	144"	-	HD	8.3	5.1
200.XXZ.01HRC	144"	-	HD	8.3	5.1
211.01Z	144"	-	ID	6.3	3.9
250.01Z	144"	✓	ID	6.3	3.9
270.XXZ.01	144"	✓	HD	8.3	5.1

Cross Tee Allowable Load Test Data Based on 1/360 Span Deflection (Lb/Ft*)

Cross Tee	Length	Fire-Rated	Cross Tee Span				
			2'	3'	4'	5'	8'
1252.01HRCZ	24"	-	32.5♦	-	-	-	-
1202.01Z	24"	-	16.5♦	-	-	-	-
1252.01Z	24"	✓	32.5♦	-	-	-	-
1210.01Z	48"	-	-	8.0♦	-	-	-
1214.01Z	48"	-	-	10.6	-	-	-
1254.01Z	48"	✓	-	10.6	-	-	-
1274.01Z	48"	✓	-	17.0	-	-	-
1214.01HRCZ	48"	-	-	10.6	-	-	-
1207.01H	60"	-	-	-	8.5	-	-
1296.01H	60"	✓	-	-	7.0	-	-
1236.01H	72"	-	-	-	-	8.0•	-
1278.01H	96"	-	-	-	-	-	8.0•

** To convert data into lb/ft², divide on center spacing of suspension component into lb/ft.*
♦ *Limited by safety factor of 2.*
• *With midspan hanger wire support.*
Install systems in accordance with ASTM C636. Other requirements may apply.

Non-Fire-Rated Light Fixture Allowable Load Test Data Based on 1/360 Span Deflection (Lbs)

Light Fixtures	Allowable Fixture Weight - Lbs. Main Runners & Cross Tees		
Dimensions	211.01Z 1210.01Z	250.01Z 1254.01Z	270.XXZ.01 1254.01Z
1' x 4'	55.6	56.4	56.4
2' x 2'	31.2	34.8	34.8
2' x 4'	52	47.2	47.2

Consult specific UL design for allowable lighting configurations.
Allowable fixture weight is based on single fixture in the field only.
For end-to-end, tandem or other configurations, contact Rockfon Technical Support.

UL® Fire-Rated Assemblies

Floor and Ceiling Designs - Type 250

A212 D209 D215 D216 D218
D219 G007 G008 G022 G201
G202 G204 G208 G209 G210
G211 G213 G214 G215 G216
G217 G218 G222 G227 G228
G229 G231 G234 G236 G241
G242 G243 G244 G248 G250
G255 G256 G258 G259 J201
L006 L201 L202 L206 L208
L209 L210 L211 L212

Roof and Ceiling Designs - Type 250

P201 P202 P203 P204 P213
P206 P207 P210 P211 P219
P214 P215 P216 P217 P230
P225 P227 P228 P229 P239
P231 P235 P237 P238 P246
P241 P242 P244 P245 P260
P250 P251 P255 P259 P261
P264

Material

ASTM C 635 Heavy Duty (HD) and Intermediate Duty (ID) main tee classifications; commercial quality HDG-30 steel, galvanized body and cap, 15/16" width, 1-41/64" height. Meets seismic code requirements. See ESR-2631.

Note: A metallurgist should be consulted regarding the suitability of this product for the environmental conditions in which it is being installed.

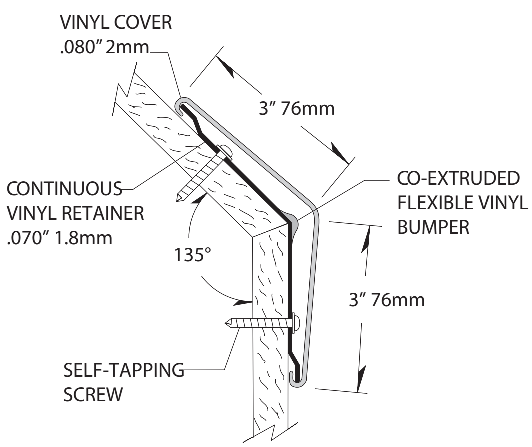
022323

Rockfon
4849 S. Austin Ave.
Chicago, IL 60638 USA

Tel. +1-800-323-7164
cs@rockfon.com
rockfon.com

130BN BluNose High Impact

Corner Guard



- 3" wing (76mm) with 135˚ blunose corner protection
- Mounted on a .070" (1.8mm) thick continuous vinyl retainer with a co-extruded Biopolymer Flex PVC apex
- Vinyl retainer is four times stronger than our aluminum retainer and six times stronger than any other vinyl retainer
- .080" (2mm) thick scratch and stain resistant rigid vinyl cover
- Manufactured in 4' (1.22m), 8' (2.44m), 9' (2.74m) and 12' (3.66m) standard heights, custom heights available
- Available in 100 standard colors and seven Woodland patterns
- Meets the most rigorous standards and criteria of chemical emissions as prescribed by the GREENGUARD Environmental Institute
- Has been tested and meets GREENGUARD Environmental Institute's and the state of California's requirements for low emitting products as tested by Air Quality Sciences
- Has been tested and meets the GREENGUARD Children & School chemical emissions levels

GREENGUARD® Indoor Air Quality Certified

IPC.386/REV.12

130BN BluNose High Impact Corner Guard

Suggested Specifications

PART 1 - GENERAL
1.01 SUMMARY
A. Corner guard system for wall protection
1.02 SECTION INCLUDES
A. 130 BluNose High Impact Surface Mount Corner Guard System
1.03 REFERENCES
A. American Society for Testing and Materials (ASTM)
B. National Building Code of Canada (NBC)
C. National Fire Protection Association (NFPA)
D. Society of Automotive Engineers (SAE)
E. Underwriters Laboratory (UL)
F. Underwriters Laboratory of Canada (ULC)
G. Uniform Building Code (UBC)
1.04 SYSTEM DESCRIPTION
A. Performance Requirements: Provide corner guard systems that conform to the following requirements of regulatory agencies and the quality control of IPC Door and Wall Protection Systems, InPro Corporation.
1. Fire Performance Characteristics: Provide UL Classified corner guards conforming with NFPA Class A fire rating. Surface burning characteristics, as determined by UL-723 (ASTM E-84), shall be flame spread of 10 and smoke development of 350 - 450.Provide ULC (Canada) listed corner guards conforming to the requirements of the National Building Code of Canada 2010, Subsection 3.1.13. Surface burning characteristics, as determined by CAN/ULC-S102.2, shall be flame spread of 15 and smoke developed of 35.
2. Self Extinguishing: Provide corner guards with a CC1 classification, as tested in accordance with the procedures specified in ASTM D-635-74, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position, as referenced in UBC 52-4-1988.
3. Impact Strength: Provide rigid vinyl profile materials that have an Impact Strength of 30.2 ft-lbs/inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics.
4. System Impact Resistance: Provide a corner guard system that resists an impact of 153.9 ft-lbs while producing no visual blemishes upon the vinyl cover surface and no deformations in the vinyl retainers, as tested in accordance with the applicable provisions of ASTM F 476-84, paragraph 18, Impact Test.
5. Chemical and Stain Resistance: Provide corner guards that show resistance to stain when tested in accordance with applicable provisions of ASTM D-543.
6. GREENGUARD Certified: Provide GREENGUARD Certified material. Profiles shall meet the requirements of GREENGUARD Certification Standards for Low-Emitting Products and GREENGUARD Product Emission Standard for Children & Schools.
7. Fungal and Bacterial Resistance: Provide rigid vinyl that does not support fungal or bacterial growth as tested in accordance with ASTM G-21 and ASTM G-22.
8. Color Consistency: Provide components matched in accordance with SAE J-1545 - (Delta E) with a color difference no greater than 1.0 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems.
1.05 SUBMITTALS
A. Product Data: Manufacturer's printed product data for each type of corner guard specified.
B. Detail Drawings: Mounting details with the appropriate fasteners for specific project substrates.
C. Samples: Verification samples of corner guard, 8" (203mm) long, in full size profiles of each type and color indicated.
D. Manufacturer's Installation Instruction: Printed installation instructions for each corner guard.
1.06 DELIVERY, STORAGE AND HANDLING
A. Deliver materials in unopened factory packaging to the jobsite
B. Inspect materials at delivery to assure that specified products have been received.
C. Store in original packaging in a climate controlled location away from direct sunlight.
1.07 PROJECT CONDITIONS
A. Environmental Requirements: Products must be installed in an interior climate controlled environment.
1.08 WARRANTY
A. Standard IPC Limited Lifetime Warranty against material and manufacturing defects.

PART 2 - PRODUCTS
2.01 MANUFACTURER
A. Acceptable Manufacturer: IPC Door and Wall Protection Systems, InPro Corporation, PO Box 406 Muskego, WI 53150 USA; Telephone: 800.222.5556, Fax: 888.715.8407, www.inprocorp.com
B. Substitutions: Not permitted
C. Provide all corner guards and wall protection from a single source.
2.02 MANUFACTURED UNITS
A. Corner Guard System
1. 130BN BluNose High Impact Surface Mount Corner Guard Profile
3" (76mm) x 3" (76mm), 135 degree
4' (1.22m), 8' (2.44m) and 9' (2.74m) standard heights.
Options: Custom heights available.
Custom Angles – Provide vinyl covers and retainers with custom angles. Custom angles shall be between 112.5° and 157.5°. Provide flexible top caps to bend to retainer angle.
2.03 MATERIALS
A. Vinyl Covers: Snap on cover of .080" (2mm) thickness shall be made from chemical and stain-resistant unplasticized polyvinyl chloride (uPVC) with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth).
B. Vinyl Retainers: Continuous vinyl retainers of .070" (1.8mm) thickness with a co-extruded Biopolymer Flex PVC apex shall be fabricated from polyvinyl chloride with the addition of impact modifiers.
2.04 COMPONENTS
A. Top caps and bottom caps shall be made of injection molded thermoplastics.
B. Fasteners: All mounting system accessories appropriate for substrates indicated on the drawings shall be provided.
C. Optional flexible top caps shall be made of injection molded Biopolymer Flex PVC.
2.05 FINISHES
A. Vinyl Covers: Colors of the corner guard to be selected by the architect from the IPC finish selection. Surface shall have a pebblette texture.
B. Molded Components: Top caps and bottom caps shall be of a color matching the corner guards. Surface shall have a pebblette texture.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine areas and conditions in which the corner guard systems will be installed.
1. Complete all finishing operations, including painting, before beginning installation of corner guard system materials.
B. Wall surface shall be dry and free from dirt, grease and loose paint.
3.02 PREPARATION
A. General: Prior to installation, clean substrate to remove dust, debris and loose particles.
3.03 INSTALLATION
A. General: Locate corner guard as indicated on approved detail drawings for the appropriate substrate and in compliance with the IPC installation instructions. Install corner guard level and plumb at the height indicated on drawings.
B. Installation of 130BN BluNose High Impact Surface Mount Corner Guard:
1. Retainer Installation:
Position the vinyl retainer against the wall, allowing $^5/_{16}$" (8mm) from the bottom of the retainer to the top of the cove base or baseboard for the bottom cap.
Drywall: Secure the retainer to the wall using #8 x 1$^1/_4$" phillips round head, self-tapping screws. Stagger the fasteners on each wing of the retainer. Use 6 screws per 4' (1.22m) length, 10 screws per 8' (2.44m) length, or 12 screws per 9' (2.74m) length.
Concrete: Drill $^1/_4$" (6.5mm) holes into the ends of the retainer for the top and bottom caps. Stagger the holes on each wing of the cap. Use the slotted tabs on the top and bottom cap to transfer hole location to the retainer. Drill $^1/_4$" (6.5mm) holes on the two wings of the retainer. Stagger the fasteners on each wing of the retainer. Drill 6 holes per 4' (1.22m) length, 10 holes per 8' (2.44m) length, or 12 holes per 9' (2.74m) length. Transfer the location of all mounting holes to the wall. Drill $^1/_4$" (6.5mm) holes and position ALLIGATOR anchors into the holes on the wall. Mount the retainer with #10 x 1$^3/_4$" phillips pan head screws and tighten to secure the retainer to the wall.
2. Top and Bottom Cap Installation:
Drywall: Overlap the retainer with the mounting tabs of the top and bottom caps and attach them to the retainer using two, #8 x 1$^1/_4$" phillips flat head, self tapping screws per cap. Stagger the fasteners on each wing of the cap.
Concrete: Overlap the retainer with the mounting tabs of the top and bottom caps and attach them to the retainer and into the ALLIGATOR anchors using two, #8 x 1$^1/_2$" phillips flat head screws per cap. When installing flexible top caps on custom angle corner guards, use cup washers and flat head screws to fasten the top caps to the retainer.
3. Position the vinyl cover on the retainer to check the fit. Adjust the top cap on the retainer to obtain a tight fit with the vinyl cover. Starting at the top, push the vinyl cover over the retainer pressing over the entire length until the cover snaps securely into place.
INSTALLATION NOTE: Vinyl retainers can be field bent to angles 10° wider or 10° tighter than 90°. When doing so use flexible top and bottom caps or the installation should be full height from floor to ceiling.
3.04 CLEANING
A. At completion of the installation, clean surfaces in accordance with the IPC clean-up and maintenance instructions.

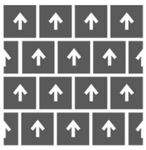
BENTLEY

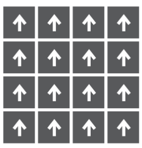
Arcade Legend

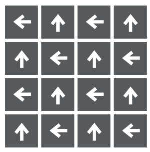
(8ALT40)

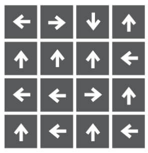
Product Code:	8ALT40221K
Construction:	Tufted Textured Loop
Fiber:	Bentley Premium™ Type 6,6 Nylon
Dye Method:	Solution Dyed
Backing & Size:	AFIRMA II™ Hardback 24x24
Yarn Weight:	14 oz/yd²
Machine Gauge:	1/12 in (47.2 ends/10 cm)
Pile Height (High):	0.135 in
Pile Height (Medium):	0.105 in
Pile Height (Low):	0.04 in
Stitches:	10.1 /in - 39.7 ends/10cm
Pile Density:	6,013 oz/yd³
Total Weight:	56 oz/yd² - 1,899 g/m²
Total Thickness:	0.205 in - 5.2 mm
Radiant Panel:	Passes Class 1, ≥ 0.45 W/cm² (ASTM-E648)
Smoke Density:	≤ 450 Dm corr (ASTM-E662), Flaming
Static:	≤ 3.5 kV (AATCC-134), Step
Flammability:	Passes Methenamine Pill Test (CPSC-FF1-70)

Installation Methods


Brick


Monolithic


Quarter_Turn


Random

Bentley's carpet products are manufactured in our California mill, a LEED Existing Buildings: Operations and Maintenance Gold certified facility. Certificates for carpet products, including Cradle to Cradle™, NSF/ANSI Standard 140 - Sustainable Carpet Assessment (NSF 140), and CRI Green Label Plus are available in Certifications under the Sustainability section of our website. Information regarding our Environmental Product Declarations, Health Product Declarations, and Declare Labels can be found in Transparency under the Sustainability section of our website. For more information, including product warranties, please visit https://www.bentleymills.com.

Patterned carpet may require special attention by the installer to assure a suitable match, and must be addressed in the original labor quotation. Repositioning of carpet tiles may be necessary to ensure light or dark lines do not align at the seams. Products that go through the shearing process may result in a small loss of yarn weight. Slight variations in color among different production lots are normal and should be considered in the overall installation plan. Carpet specifications andcomponents are subject to normal manufacturing tolerances and may change without notice. Product warranted in accordance with the terms and conditions of Bentley's standard printed warranty in effect at time product is sold. All other warranties, including without limitation any implied warranties of merchantability or fitness for a particular purpose, are hereby disclaimed. Made in USA. Warning: unauthorized reproduction of this carpet design constitutes copyright infringement.

AmericanBiltrite Flooring

TEXAS GRANITE®
SOLID VINYL TILE
TECHNICAL SPECIFICATIONS

	Metric	Imperial
Gauge	3.17 mm	1/8"
Sizes	305 mm x 305 mm Micro-Ground™ 610 mm x 610 mm Micro-Ground™ 915 mm x 915 mm	12" x 12" Micro-Ground™ 24" x 24" Micro-Ground™ 36" x 36"
Product Classification: ASTM F1700 - Solid Vinyl Floor Tile	Class I, Type A, Monolithic	
ASTM D2047 – Static Coefficient of Friction (leather)	≥ 0.5	
ASTM D3389 – Abrasion Resistance (H-22, 500g @ 1,000 cycles)	Pass	
ASTM E648 – Critical Radiant Flux CRF (W/cm²)	≥ 0.45	
ASTM E662 – Smoke Density	≤ 450	
ASTM F137 – Flexibility	Pass	
ASTM F925 – Chemical Resistance	Meets requirements (details upon request)	
ASTM F970 – Static Load (modified at 2500 psi)	≤ 0.005"	
ASTM F1514 – Heat Stability	ΔE ≤ 8.0	
ASTM F1515 – Light Stability	ΔE ≤ 8.0	
ASTM F1914 – Indentation	Residual < 8 %	
ASTM F2055 – Squareness	0.010" maximum	
Indoor Air Quality (IAQ): Volatile Organic Compounds (VOC's)	FloorScore Certified by SCS Certification Registration Number SCS-FS-01495	
Maintenance	No waxing	
Adhesives: AD-610 AD-590	Regular traffic Heavy rolling traffic	
Limited Wear Warranty	20 years	

Please note that technical web site documents prevail.

floor score

ISO 9001•14001 CERTIFIED

AmericanBiltrite
Flooring

ELECTROTILE®

TECHNICAL SPECIFICATIONS

	Metric	Imperial
CONDUCTIVE & DISSIPATIVE MONOLITHIC SOLID VINYL TILE		
Gauge	3.17 mm	0.125"
Sizes	305 mm x 305 mm Micro-Ground™ 610 mm x 610 mm Micro-Ground™ 915 mm x 915 mm	12" x 12" Micro-Ground™ 24" x 24" Micro-Ground™ 36" x 36"
Product Classification: Solid Vinyl Floor Tile	ASTM F1700, Class I, Type A, Monolithic	
ASTM F150 – Electrical Resistance: Conductive Tile	Between 25 x 10^3Ohms and 1 x 10^6 Ohms (0.025 MOhms and 1 MOhms)	
ASTM F150 – Electrical Resistance: Dissipative Tile	Between 1 x 10^6 Ohms and 1 x 10^9 Ohms (1 MOhms and 1,000 MOhms)	
Federal Standard Test Method 101 B, Method 4048 (Static Decay 5,000 Volts to 0 Volt)	Complies	
ASTM D2047 – Static Coefficient of Friction (leather/Neolite)	≥ 0.5	
ASTM D3389 – Abrasion Resistance (H-22, 500 g @ 1,000 cycles)	Pass	
ASTM E648 – Critical Radiant Flux CRF (W/cm^2)	≥ 0.45	
ASTM E662 – Smoke Density	≤ 450	
ASTM F137 - Flexibility	Pass	
ASTM F925 – Chemical Resistance	Meets requirements (details upon request)	
ASTM F970 – Static Load	≤ 0.005”	
ASTM F1514 – Heat Stability	ΔE ≤ 8.0	
ASTM F1515 – Light Stability	ΔE ≤ 8.0	
ASTM F1914 – Indentation	Residual < 8%	
ASTM F2055 - Squareness	0.010’’ maximum	
AATCC, Method 134 - Static Propensity	Complies	
Indoor Air Quality (IAQ) Volatile Organic Compounds (VOC’s)	FloorScore Certified by SCS Certification Registration Number SCS-FS-01495	
Adhesive: AD-390C (two-part epoxy) AD-333SF (one-part acrylic)	Regular traffic & Heavy rolling loads Regular traffic	
Grounding	Required – use 3/8" wide copper foil tape	
Maintenance	No waxing	
Limited Wear Warranty	20 years – product Lifetime – conductivity	

Please note that technical web site documents prevail.

floor score

ISO 9001•14001 CERTIFIED

Tarkett

Traditional Wall Base

Product Specification

1. PROPRIETARY PRODUCT/MANUFACTURER

1.1. **Proprietary Product**: Thermoplastic Wall Base

1.2. **Manufacturer:**
Tarkett North America — Phone: (800) 899-8916
30000 Aurora Rd. — (440) 543-8916
Solon, Ohio 44139
Web: www.tarkett.com

1.3. **Proprietary Product Description:**

1.3.1. **Construction:** Tarkett Traditional Wall Base is manufactured from a proprietary rubber and vinyl formulation designed specifically to meet the performance and dimensional requirements of ASTM F-1861, Type TV (Thermoplastic Vinyl) and TP (Thermoplastic Rubber), Group 1 (solid), Style A and B, Standard Specification for Resilient Wall Base.

1.3.2. **Styles/Physical Characteristics:**

Rubber Wall Base

- **Traditional**: DC-XX with toe (coved) or DCT-XX for toeless (straight), 0.125" (3.17 mm) thickness, 2-1/2" (6.35 cm), 4" (10.16 cm), 4 1/2" (11.4 cm) or 6" (15.24 cm) height

  Available in 4' (1.22 m) straight lengths and 120' (36.58 m) coiled lengths. The 6" (15.24 cm) high profile available in 4' (1.22 m) straight lengths and 100' (30.48 m) coiled lengths

- **Wall Art**: WA-XX w/toe (coved), 0.125" (3.17 mm) thickness, 4" (10.16 cm) height

  Available in 4' (1.22 m) straight lengths only

- **Inside and Outside Corners** available with 4" (10.16 cm) returns packaged 25 per carton, add LIC (Inside corners) or LOC (Outside corners)

Vinyl Wall Base

- **Traditional**: CB-XX with toe (coved) or CBT-XX toeless (straight), 0.125" (3.17 mm) or 0.080" thickness, 2-1/2" (6.35 cm), 4" (10.16 cm), or 6" (15.24 cm) height

  Cartons size: Available in 4' (1.22 m) straight lengths and 120' (36.58 m) coiled lengths. The 6" (15.24 cm) high profile available in 4' (1.22 m) straight lengths and 100' (30.48 m) coiled lengths

- **Inside and Outside Corners** available with 4" (10.16 cm) returns packaged 25 per carton, add LIC (Inside corners) or LOC (Outside corners)

2. PRODUCT PERFORMANCE AND TECHNICAL DATA

2.1. Meets or exceeds the performance requirements for resistance to heat/light aging, chemicals, and dimensional stability when tested to the methods, as described, in ASTM F-1861.

2.2. **Flexibility**: Will not crack, break, or show any signs of fatigue when bent around a 1/4" (6.4 mm) diameter cylinder.

2.3. **Chemical resistance** (ASTM F 925): Passes – 5% acetic acid, 70% isopropyl alcohol, mineral oil, 5% sodium hydroxide solution, 5% hydrochloric acid solution, 5% sulfuric acid solution, 5% household ammonia solution, and 5.25% household bleach solution

2.4. **Resistance to light** (ASTM F 1515)**:** ΔE< 8

2.5. **Fire Resistance:**

Vinyl Wall Base

ASTM E 648 (NFPA 253): Critical Radiant Flux – Class I

Rubber Wall Base

ASTM E 648 (NFPA 253): Critical Radiant Flux – Class I

2.6. **CAN/ULC-S102.2:**

Vinyl Wall Base

FSR 140 / SDV 330

Rubber Wall Base

FSR 165 / SDV 345

3. AVAILABILITY AND COST

For availability and cost contact authorized Tarkett distributors nationwide.

4. INSTALLATION

4.1. See Tarkett wall base installation instructions for complete details.

4.2. **Adhesives:**

- **Tarkett 960 Cove Base Adhesive** (Porous surfaces):
  Application: 1/8” x 1/8” x 1/8” square notched trowel
  Approximate coverage:
  2 ½" high – 300 to 350 linear feet/gallon
  4" high – 200 to 250 linear feet/gallon
  6" high – 100 to 150 linear feet/gallon

- **Tarkett 946 Premium Contact Adhesive** (Non-porous surfaces)
  Application: Brush or roller
  Approximate coverage:
  1 Quart (0.95 liters) – 24 to 36 sq. ft.
  1 Gallon (3.79 liters) – 100 to 150 sq. ft.

Tarkett North America
Technical Services Department
30000 Aurora Road
Solon, Ohio 44139
800.899.8916
info@tarkettna.com
www.tarkett.com

Tarkett

Traditional Wall Base

Product Specification

5. MAINTENANCE

72 hours after installation is completed, initial maintenance procedures must be implemented in accordance with manufacturer's requirements. Refer to the Rubber Vinyl Wallbase Installation & Maintenance instructions for full details.

6. TECHNICAL SERVICES

Visit us on the web at **www.tarkett.com**

Contact Technical Support at (800) 899-8916 or E-mail: **Resilient.TechnicalSupport@Tarkett.com**

Samples: Submittal samples for verification and approval available upon request from Tarkett. Samples shall be submitted in compliance with the requirements of the contract documents. Accepted and approved samples shall constitute the standard materials which represent materials installed on the project.

7. LIMITED WARRANTY

Limited 2 year warranty. For complete details, contact Tarkett or an authorized Tarkett distributor

Tarkett North America
Technical Services Department
30000 Aurora Road
Solon, Ohio 44139
800.899.8916
info@tarkettna.com
www.tarkett.com

Tarkett

Color Splash — Product Specification

1. PROPRIETARY PRODUCT/MANUFACTURER

1.1. **Proprietary Product**: Resilient MicroTone™ & Color Splash Rubber Floor Tiles

1.2. **Manufacturer:**
Tarkett North America Phone: (800) 899-8916
30000 Aurora Rd. (440) 543-8916
Solon, Ohio 44139
Web: www.tarkett.com

1.3. **Proprietary Product Description:**

1.3.1. **Construction:** Tarkett MicroTone™ & Color Splash Rubber Floor Tiles are manufactured from a homogeneous composition of 100% synthetic rubber, high quality additives, and colorants to meet the performance requirements of ASTM F 1344, Class 1 - B Standard Specification for Rubber Floor Tile.

Tarkett MicroTone™ & Color SplashRubber Floor Tiles are designed for interior applications only and not recommended for environments where the product will be exposed to animal fats, vegetable oils, or petroleum based materials (e.g.: commercial kitchens). Tarkett rubber floor tiles require the use of chair pads or chairs with casters designed for resilient flooring in work stations or similar environments. Tarkett rubber floor tiles are not warranted against cuts or lack of protection under caster wheels designed for carpeting or other types of flooring.

1.3.2. **Styles**:

- **HNSP XX – Hammered** Surface Rubber Floor Tile, specify 0.080" (2 mm) thickness, 24" x 24" (61 cm x 61 cm)
- **HRTSP XX - Hammered** Surface Rubber Floor Tile, specify 0.125" (3.17 mm) thickness, 24" x 24" (61 cm x 61 cm)
- **FRPANSP XX – Rice Paper** Surface Pattern Rubber Tile, specify 0.080" (2 mm) thickness, 24" x 24" (61 cm x 61 cm)
- **FRPASP XX - Rice Paper** Surface Pattern Rubber Tile, specify 0.125" (3.17 mm) thickness, 24" x 24" (61cm x 61cm)
- **RTSP XX RD – Raised Round** Disk Pattern Rubber Tile, specify 0.125" (3.17 mm) thickness, 24" x 24" (61cm x 61cm)
- **RTSP XX SQ – Raised Square** Disk Pattern Rubber Tile, specify 0.125" (3.17 mm) thickness, 24" x 24" (61cm x 61cm)
- **BMRTSP XX – Bamboo** Surface Pattern Rubber Tile, specify 0.125" (3.17 mm) thickness, 24" x 24" (61 cm x 61 cm)

1.3.3. **Physical Characteristics:**

Tile Size and Packaging:

- 24" x 24" (61 cm x 61 cm), .125" – 8 tiles per carton, 32 ft² (3.0 m²) per carton, 35 lbs per carton
- 24" x 24" (61 cm x 61 cm), .080" (2 mm) – 12 tiles per carton, 48 ft² (4.5 m²) per carton, 35 lbs per carton

2. PRODUCT PERFORMANCE AND TECHNICAL DATA

2.1. **Hardness** (ASTM D 2240): Not less than 85 Shore A

2.2. **Abrasion Resistance** (ASTM D 3389): <1.0 gm weight loss

2.3. **Slip Resistance** (ASTM D 2047): ≥ 0.5 SCOF

2.4. **Color Heat Stability** (ASTM F 1514): < 8.0 ΔE

2.5. **Static Load Limit** (ASTM F 970): Passes (250 psi load)

2.5. **Fire Resistance**:

- ASTM E 648/NFPA 253 (Critical Radiant Flux), Class 1
- ASTM E 662/NFPA 258 (Smoke Density), less than 450

2.6 **Chemical Resistance:** ASTM F 925, Passed - 5% Acetic acid, 70% Isopropyl alcohol, Sodium hydroxide solution (5% NaOH), Hydrochloric acid solution (5% HCl), Sulfuric acid solution (5% H_2SO_4), Household ammonia solution (5% NH_4OH), Household bleach (5.25% NaOCl), Disinfectant cleaner (5% active phenol)

2.7 **CAN/ULC S102.2:** FSR 45 / SDR 265

3. INSTALLATION

See Tarkett rubber floor tile installation instructions for complete details.

3.1. <u>**Adhesives**</u>:

- **Tarkett 965 Adhesive Coverage**:
  Porous Substrate: 125-150 sq. ft. per gallon
  Non-porous Substrate: 150-175 sq. ft. per gallon
- **Tarkett 996 Two-Part Epoxy Adhesive Coverage**:
  Porous & Non-porous Substrate: 150-175 sq. ft. per gallon
- **Tarkett 975 Two-Part Polyurethane Adhesive Coverage**:
  Porous & Non-porous Substrate: 150-175 sq. ft. per gallon
- **Tarkett 901 SpraySmart Adhesive Coverage**:
  Porous & Non-porous Substrate: 80 sq. ft. per can (480 sq. ft. per carton)

4. AVAILABILITY AND COST

Available through authorized Tarkett distributors nationwide.

Tarkett North America
Technical Services Department
30000 Aurora Road
Solon, Ohio 44139
800.899.8916
info@tarkettna.com
www.tarkett.com

Color Splash | Product Specification

5. **MAINTENANCE**

72 hours after installation is completed, initial maintenance procedures must be implemented in accordance with manufacturer's requirements. Refer to Johnsonite rubber tile maintenance Instructions for complete maintenance details.

6. **TECHNICAL SERVICES**

Visit us on the web at **www.tarkett.com**

Contact Technical Support at (800) 899-8916 or E-mail: **Resilient.TechnicalSupport@tarkett.com**

Samples: Submittal samples for verification and approval available upon request from Tarkett. Samples shall be submitted in compliance with the requirements of the contract documents. Accepted and approved samples shall constitute the standard materials which represent materials installed on the project.

7. **WARRANTY**

Limited 5-year warranty. For complete details, contact Tarkett or an authorized Tarkett distributor.

Tarkett North America
Technical Services Department
30000 Aurora Road
Solon, Ohio 44139
800.899.8916
info@tarkettna.com
www.tarkett.com

Angle Fit™ Rubber Stair Treads with Integrated Riser

Product Specification

1. PROPRIETARY PRODUCT/MANUFACTURER

1.1. **Proprietary Product:** Resilient Rubber Stair Treads A.D.A. compliant.

1.1. **Manufacturer:**

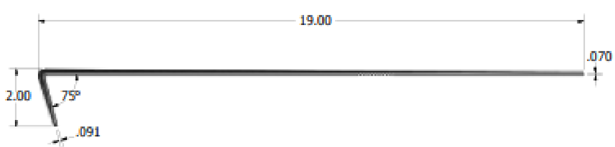
Tarkett North America Phone (800) 899-8916
30000 Aurora Rd.
Solon, Ohio 44139
Web: www.tarkett.com
E-mail: info@tarkett.com

1.2. **Proprietary Product Description:**

1.1.1. **Construction:** Tarkett Rubber Stair Treads are manufactured from a homogeneous composition of 100% synthetic rubber, high quality additives, and colorants to meet the performance requirements of ASTM F-2169 Standard Specification for Resilient Stair Treads, Type TS, Class 1 and 2, Group 1 and 2. All Tarkett Stair Treads are available with a 2" (5.08 cm) wide strip of contrasting color to comply with A.D.A., Visually-Impaired, and California Title 24 requirements. Standard formulation exceeds ASTM E 648 Class 1 Flammability requirements.

1.2.1. **Styles & Physical Characteristics:**

Square Nose:



See table below for sizes and options available per texture.

2. PRODUCT PERFORMANCE AND TECHNICAL DATA

2.1. **Hardness (**ASTM D 2240): Not less than 85 Shore A

2.2. **Abrasion Resistance** (ASTM D 3389): < 1 gram weight loss

2.3. **Slip Resistance** (ASTM D 2047): ≥ 0.5 SCOF

2.4. **Fire Resistance:** ASTM E 648/NFPA 253 (Critical Radiant Flux): Class 1 (Minimum 0.45 W/cm^2)

2.5. **Smoke Development** (ASTM E 662/NFPA 258): less than 450

2.6. **CAN/ULC S102.2**: FSR 120 / SDC 460

3. INSTALLATION

3.1. See Tarkett Stair Tread installation instructions for complete details.

3.2. **Adhesive Coverage:**

- **Tarkett 965**
  - Porous Substrate: 1/16x1/16x1/16 SQ-notch – 125-150 sq. ft. per gallon
  - Non-porous Substrate: 1/16x1/16x1/16 V-notch – 150-175 sq. ft. per gallon
- **Tarkett 946 Premium Contact Adhesive** (For Nose only when the angle of the stair nose is smaller than the tread template)

  Application: Brush or roller
  - 1 quart unit (0.95 liters) – 24 to 36 sq. ft.
  - 1 gallon unit (3.79 liters) – 144 to 215 sq. ft.
- **Tarkett 930 Two-Part Epoxy Caulking Compound** (For nose only when the stair nose radius is greater than ½" [12.7mm] or in need of repair)

  Application: 13.5 oz. cartridge, Gun at ¼" diameter bead (Use Tarkett 530 dual-cartridge dispenser gun with cartridge)
  - Approximately 50 linear ft. / cartridge

4. AVAILABILITY AND COST

Available through authorized Tarkett distributors nationwide.

5. MAINTENANCE

72 hours after installation is completed, initial maintenance procedures must be implemented in accordance with manufacturer's requirements. Refer to Stairwell Maintenance Instructions for complete maintenance details.

6. TECHNICAL SERVICES

Visit us on the web at www.tarkett.com
Contact Technical Support at (800) 899-8916 or E-mail: Resilient.TechnicalSupport@Tarkett.com

Samples: Submittal samples for verification and approval available upon request from Tarkett. Samples shall be submitted in compliance with the requirements of the contract documents. Accepted and approved samples shall constitute the standard materials which represent materials installed on the project.

7. WARRANTY

Limited 5 year warranty. For complete details, contact Tarkett or an authorized Tarkett distributor

Angle Fit™ Rubber Stair Treads with Integrated Riser

Product Specification

Tread Type	Tread With 1-Piece Riser	Visually Impaired Grit Tape Insert	Visually Impaired Rubber Insert	Nose	Overall Depth	Nominal Length* 3', 3.5', & 9 foot are NON-RETURNABLE	Pieces Per Ctn.	Weight Per Ft.
RAISED ROUND SURFACE - ONE PIECE TREAD/RISER	**RNRDTR**	**VIRNRDTR**	**VIRNRDTRS**	SQ	19"	3', 3.5', 4', 4.5', 5', 6', 7', 8', 9'	Up to 6' - 5 pcs - Greater than 6' - 3 pcs	2.2 lbs.
RAISED SQUARE SURFACE - ONE PIECE TREAD/RISER	**RNSQTR**	**VIRNSQTR**	**VIRNSQTRS**	SQ	19"	3', 3.5', 4', 4.5', 5', 6', 7', 8', 9'	Up to 6' - 5 pcs - Greater than 6' - 3 pcs	2.2 lbs.
HAMMERED SURFACE ONE PIECE TREAD/RISER	**HNTR**	**VIHNTR**	**VIHNTRS**	SQ	19"	3', 3.5', 4', 4.5', 5', 6', 7', 8', 9'	Up to 6' - 5 pcs - Greater than 6' - 3 pcs	2.2 lbs.
DIAMOND SURFACE ONE PIECE TREAD/RISER	**CNNTR**	**VICNNTR**	**VICNNTRS**	SQ	19"	3', 3.5', 4', 4.5', 5', 6'	5 pcs.	2.2 lbs.
BAMBOO SURFACE ONE PIECE TREAD/RISER	**BMNTR**	**VIBMNTR**	**VIBMNTRS**	SQ	19"	3', 3.5', 4', 4.5', 5', 6'	5 pcs.	2.2 lbs.
CUBIS SURFACE ONE PIECE TREAD/RISER	**CUBTR**	**VICUBTR**	**VICUBTRS**	SQ	19"	3', 3.5', 4', 4.5', 5', 6'	5 pcs.	2.2 lbs.
CIRCULINITY - FAST LANE PATTERN ONE PIECE TREAD/RISER	**CFLNTR**	**VICFLNTR**	**VICFLNTRS**	SQ	19"	3', 3.5', 4', 4.5', 5', 6'	5 pcs.	2.2 lbs.
RICE PAPER SURFACE ONE PIECE TREAD/RISER	**FRPANTR**	**VIFRPANTR**	**VIFRPANTRS**	SQ	19"	3', 3.5', 4', 4.5', 5', 6'	5 pcs.	2.2 lbs.

***NOTE: In applications where the staircase is the same width as Tarkett Stair Treads, Nosings, Risers, and Stringers, order the next size up to allow for proper installation.**

Tarkett North America
Technical Services Department
30000 Aurora Road
Solon, Ohio 44139
800.899.8916
info@tarkettna.com
www.tarkett.com

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APPENDIX B

TECHNICAL SPECIFICATIONS FOR CONSTRUCTION AND MANAGEMENT OF SENSITIVE COMPARTMENTED INFORMATION FACILITIES (VERSION 1.5.1)

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NATIONAL COUNTERINTELLIGENCE AND SECURITY CENTER

Advancing Counterintelligence and Security Excellence

Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities

VERSION 1.5.1

IC Tech Spec – for ICD/ICS 705

An Intelligence Community Technical Specification
Prepared by the
National Counterintelligence and Security Center

July 26, 2021

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OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE
DIRECTOR OF THE NATIONAL COUNTERINTELLIGENCE AND SECURITY CENTER
WASHINGTON, DC

NCSC-2021-00068

MEMORANDUM FOR:	Distribution
SUBJECT:	Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.5.1, Chapter 13, Second Party Integree and Second Party Liaison Spaces within U.S. Sensitive Compartmented Information Facilities
REFERENCES:	A. Technical Specifications, Version 1.5, 13 Mar 20 (U) B. ICD 705, Sensitive Compartmented Information Facilities, 26 May 10 (U) C. ICS 705-01, Physical and Technical Standards for Sensitive Compartmented Information Facilities, 27 Sep 10 (U) D. ICS 705-02, Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities, 22 Dec 16 (U)

This memorandum promulgates modifications to Chapter 13 of the Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities (SCIF) Version 1.5, dated 13 Mar 2020 (Ref A) to the Intelligence Community (IC), which are effective upon signature of this memorandum.

This Chapter establishes general guidance to our stakeholders for implementing personnel, physical, and technical security standards prior to assigning and placing Second Party officers within United States SCIFs in accordance with authorized agreements.

The Technical Specifications are designed to be a living document that enables periodic updates to keep pace with changes that significantly impact protection of SCIFs from compromising emanations, inadvertent observations, and disclosure by unauthorized persons. To this end, guidance described in this addendum was developed in tandem with physical and technical experts from IC elements and with our industrial partners to arrive at robust security practices that will further supplement and bolster standards identified in ICS 705-01, Physical Security Standards for Sensitive Compartmented Information Facilities and ICS 705-02, Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities.

SUBJECT: Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.5.1, Chapter 13, Second Party Integree and Second Party Liaison Spaces within U.S. Sensitive Compartmented Information Facilities

Please contact the National Counterintelligence and Security Center's Special Security Directorate at DNI-NCSC-SSD-CSG-PTSP-Mailbox@cia.ic.gov.

Michael J Orlando

JUL 26 2021

Michael J. Orlando
Acting Director

Date

Attachment:
Chapter 13 Modification_Version 1.5.1

Distribution:
Secretary of State, Department of State
Secretary of the Treasury, Department of the Treasury
Secretary of Defense, Department of Defense
Attorney General, Department of Justice
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Chairman, Federal Communications Commission
Chairman, Federal Maritime Commission
Chairman, Federal Reserve System
Chairman, Federal Trade Commission
Administrator, General Services Administration

SUBJECT: Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.5.1, Chapter 13, Second Party Integree and Second Party Liaison Spaces within U.S. Sensitive Compartmented Information Facilities

Administrator, National Aeronautics and Space Administration
Archivist, National Archives and Records Administration
Director, National Science Foundation
Chairman, Nuclear Regulatory Commission
Director, Office of Government Ethics
Chairman, Privacy and Civil Liberties Oversight Board
Chairman, Security and Exchange Commission
Director, Selective Service System
Commissioner, Social Security Administration
Administrator, United States Agency for International Development
United States Postal Service
Chairman, United States International Trade Commission
Director, United States Peace Corps
Office of the Chief Administrative Officer

Change History

Rev. #	Date	Page	Changes	Approver
1.2	04/23/12	Cover	Banner Graphic, Version, Date	PTSEWG
1.2	04/23/12	4	Added note to warn users of classification when associating threat information and facility location.	PTSEWG
1.2	04/23/12	5	Re-worded approval of CAs to designate the AO as the primary approval authority of Compartmented Areas within SCIFs.	PTSEWG
1.2	04/23/12	9-10	Changed “Type X Gypsum” to “wallboard” to remove the standard of fire resistant gypsum and permit use of other wallboard types.	PTSEWG
1.2	04/23/12	9-10	Changed references to wall design drawings to “suggested” wall types to enable variety of wall construction techniques to meet the security standards.	PTSEWG
1.2	04/23/12	10	Added explanation to glue and screw plywood to ceiling and floor to clarify standard. Stud placement changed to 16 on center to match drawing and correct error.	PTSEWG
1.2	04/23/12	11	Added statement to finish wall and paint from true floor to true ceiling in Walls B and C to clarify and equal Type A Wall.	PTSEWG
1.2	04/23/12	9-10	Replaced drawings to reflect “suggested” wall construction methods and remove references to “Type X gypsum wallboard”.	PTSEWG
1.2	04/23/12	17-19	Replaced drawings to reflect “suggested” wall construction methods and remove references to “Type X gypsum wallboard”.	PTSEWG
1.2	04/23/12	56	Updated Federal Information Processing Standards (FIPS) encryption standards and certification to remove a standard that could not be met by commercial alarm systems.	PTSEWG
1.2	04/23/12	64	Replaced FIPS 140-2 with Advanced Encryption Standard (AES) to remove	PTSEWG

			a standard that could not be met by commercial alarm systems.	

Rev. #	Date	Page	Changes	Approver
1.2	04/23/12	TEMPEST Checklist	Removed references to "inspectable space" as requested by the TEMPEST Advisory Group (TAG).	PTSEWG
1.2	04/23/12	TEMPEST Checklist	Removed references to "Red-SCI" information.	PTSEWG
1.2	04/23/12	TEMPEST Checklist	Removed parenthetical reference to cell phones and Bluetooth.	PTSEWG
1.2	04/23/12	CA Checklist	Replaced Compartmented Area Checklist to reflect IC standards.	PTSEWG
1.2	04/23/12	SCIF Co-Use Request and MOA Form	Replaced Co-Use and MOA Form to include "joint-use" statements.	PTSEWG
1.3	03/26/15	Cover	Banner change, version, date	PTSEWG
1.3	03/26/15	B-C	Appended "D/NCSC Memorandum"	PTSEWG
1.3	03/26/15	D-G	"Appended Change History"	PTSEWG
1.3	03/26/15	3	Chapter 2.A (2)(a) Added: "NOTE" regarding prefabricated modular SCIFs.	PTSEWG
1.3	03/26/15	9	Chapter 3.C Corrected wording to match wall drawings on p.21.	PTSEWG
1.3	03/26/15	14	Chapter 3.G (7)(c.4) Correction and addition of guidance on vents and ducts perimeter protection.	PTSEWG
1.3	03/26/15	17-19	Reformatted wall types to reflect correct architectural graphics for prescribed materials.	PTSEWG
1.3	03/26/15	53	Chapter 7.A (2)(d) Added requirement for HSS switches.	PTSEWG
1.3	03/26/15	54	Chapter 7.A (2)(k) Changed to reflect restrictions on dissemination of installation plans.	PTSEWG
1.3	03/26/15	54	Chapter 7.A (3)(a.2) Added exception that sensors must be located within SCIF perimeter.	PTSEWG
1.3	03/26/15	55	Chapter 7.A (3)(b.7.e) Replaced "Zones" with "IDE sensor points".	PTSEWG
1.3	03/26/15	56	Chapter 7.A (3)(c.1) Added language for approval authority.	PTSEWG

1.3	03/26/15	56	Chapter 7.A (3)(c.2) Added language for integrated IDS and Remote Access.	PTSEWG
1.3	03/26/15	56-57	Chapter 7.A (3)(c.2) Added system application software requirements.	PTSEWG
1.3	03/26/15	58-59	Replaced "access/secure" with "arm/disarm" throughout.	PTSEWG
Rev. #	**Date**	**Page**	**Changes**	**Approver**
1.3	03/26/15	58	Chapter 7.B (2) Added "A record shall be maintained that identifies the person responsible for disarming the system".	PTSEWG
1.3	03/26/15	87	Chapter 12.G (2) Changed Section header to read "Inspections/Reviews, added same where the term "inspection" or "review" used. The responsibility to perform as such was changed from "IC element head" to the AO, or designee.	PTSEWG
1.3	03/26/15	SCIF Co-Use Request and MOA Form	Appended Co-Use Request and MOA Form	PTSEWG
1.4	06/27/17	Cover	Banner change, version, date	PTSEWG
1.4	06/27/17	i-iii	Appended "D/NCSC Memorandum"	PTSEWG
1.4	06/27/17	iv-vii	"Appended Change History"	PTSEWG
1.4	06/27/17	1	Chapter 1.B.2 Added SAPF Language	PTSEWG
1.4	06/27/17	12	Chapter 3.E.1.b Added egress device language	PTSEWG
1.4	06/27/17	60	Chapter 7.C.1.c Added, "…IAW UL 2050 requirements (60 minutes)"	PTSEWG
1.4	06/27/17	71-74	Chapter 10 Revised	PTSEWG
1.4	06/27/17	75-76	Chapter 11.B.5 Added sub-bullets to address CNSSI 5002	PTSEWG
1.4	06/27/17	90-91	Chapter 12.L1/2/7 Added clarification language	PTSEWG
1.4	06/27/17	91-92	Chapter 12.M.4 Synchronized bullets	PTSEWG
1.5	11/13/19	3-4	Chapter 2.A.3.a Added clarification language	PTSEWG
1.5	11/13/19	5-6	Chapter 2.C.2	PTSEWG

			Defined CA Types	
1.5	11/13/19	8	Chapter 3. Added Pre-Construction Checklist language	PTSEWG
1.5	11/13/19	13-15	Chapter 3.E Expanded SCIF Door Criteria	PTSEWG
1.5	11/13/19	30	Chapter 4.E.2 Added reference to Inspectable Materials Checklist	PTSEWG
1.5	11/13/19	35	Chapter 5.A Added language in Applicability	PTSEWG
1.5	11/13/19	46	Chapter 6.A.1.a Added exception language	PTSEWG
1.5	11/13/19	74-77	Chapter 10 Changed "CSA" to "AO" where appropriate	PTSEWG
1.5	11/13/19	90	Chapter 12.G.8 Added TSCM language to Inspections/Reviews	PTSEWG
1.5	11/13/19	95-97	Chapter 12.N/O/P Added CUA instructions	PTSEWG
1.5	11/13/19	98	Chapter 13 Updated FFC and added CUA Guide and Cancellation Forms, Inspectable Materials Checklist, Pre-construction Checklist,	PTSEWG
1.5.1	07/26/21	Cover	Version and Date Change	PTSEWG
1.5.1	07/26/21	i-iii	Appended "D/NCSC Memorandum"	PTSEWG
1.5.1	07/26/21	iv-vii	Appended "Change History"	PTSEWG
1.5.1	07/26/21	104/113	Chapter 13, FVEY Chapter inserted. Changing Original Chapter 13, Forms & Plans to Chapter 14, Forms & Plans	PTSEWG

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Table of Contents

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Chapter 1. Introduction

A. Purpose

This Intelligence Community (IC) Technical Specification sets forth the physical and technical security specifications and best practices for meeting standards of Intelligence Community Standard (ICS) 705-01 (Physical and Technical Standards for Sensitive Compartmented Information Facilities). When the technical specifications herein are applied to new construction and renovations of Sensitive Compartmented Information Facilities (SCIFs), they shall satisfy the standards outlined in ICS 705-01 to enable uniform and reciprocal use across all IC elements and to assure information sharing to the greatest extent possible. This document is the implementing specification for Intelligence Community Directive (ICD) 705 (Sensitive Compartmented Information Facilities), ICS 705-01, and ICS 705-02 (Standards for Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities.

The specifications contained herein will facilitate the protection of Sensitive Compartmented Information (SCI) against compromising emanations, inadvertent observation and disclosure by unauthorized persons, and the detection of unauthorized entry.

B. Applicability

IC Elements shall fully implement this standard within 180 days of its signature.

1. SCIFs that have been de-accredited but controlled at the SECRET level (IAW 32 Code of Federal Regulations (CFR) parts 2001 and 2004) for less than one year may be re-accredited. The IC SCIF repository shall indicate that the accreditation was based upon the previous standards.

2. When the technical specifications herein have been applied to new construction, renovations, and operation of Special Access Program Facilities (SAPFs), those facilities shall satisfy the standards outlined in ICD 705 to enable uniform use across all IC elements for accreditation by IC elements as a Sensitive Compartmented Information Facility.

   a) Accreditation of a SAPF as a SCIF will be based upon a review of all required SCIF construction documentation to ensure all ICD 705 requirements were met in the construction, maintenance, and operation of the SAPF.

   b) The Accrediting Official (AO) will conduct a review of all SAPF accreditation documentation for compliance with the technical specifications herein.

      (1) If all required documentation is available and correct, the AO will issue SCIF accreditation.

      (2) If all required documentation is not available and correct, or waivers have been authorized, the AO is not required to issue SCIF accreditation.

c) If the facility is to be maintained as a SAPF and co-utilized as a SCIF, the security posture of the facility will be to the highest requirement of the two.

(1) The AO may issue a more restrictive accreditation based upon the SCI requirements associated with the new SCIF accreditation. For example, 5 minute response versus 15 minutes, or Closed Storage versus Open Storage.

(2) Program indoctrination will be coordinated as part of the co-utilization agreement. Compartmented Areas may be utilized, but no other sub-division of the facility will be permitted. Facilities requiring additional protections are not suitable for co-utilization.

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Chapter 2. Risk Management

A. Analytical Risk Management Process

1. The Accrediting Official (AO) and the Site Security Manager (SSM) should evaluate each proposed SCIF for threats, vulnerabilities, and assets to determine the most efficient countermeasures required for physical and technical security. In some cases, based upon that risk assessment, it may be determined that it is more practical or efficient to mitigate a standard. In other cases, it may be determined that additional security measures should be employed due to a significant risk factor.

2. Security begins when the initial requirement for a SCIF is known. To ensure the integrity of the construction and final accreditation, security plans should be coordinated with the AO before construction plans are designed, materials ordered, or contracts let.

   a) Security standards shall apply to all proposed SCI facilities and shall be coordinated with the AO for guidance and approval. Location of facility construction and or fabrication does not exclude a facility from security standards and or review and approval by the AO. SCI facilities include but are not limited to fixed facilities, mobile platforms, prefabricated structures, containers, modular applications or other new or emerging applications and technologies that may meet performance standards for use in SCI facility construction.

   NOTE: Advertised claims by manufactures that their product(s), to include mobile platforms, prefabricated structures, containers and modular structures are built to SCIF standards and can be accredited without modification may not be accurate. AOs are responsible for ensuring security controls spelled out in the ICD/ICS 705 series and this document are implemented to protect the security integrity of the proposed SCIF prior to accreditation.

   b) Mitigations are verifiable, non-standard methods that shall be approved by the AO to effectively meet the physical/technical security protection level(s) of the standard. While most standards may be effectively mitigated via non-standard construction, additional security countermeasures and/or procedures, some standards are based upon tested and verified equipment (e.g., a combination lock meeting Federal Specification FF-L 2740) chosen because of special attributes and could not be mitigated with non-tested equipment. The AO's approval is documented to confirm that the mitigation is at least equal to the physical/technical security level of the standard.

   c) Exceeding a standard, even when based upon risk, requires that a waiver be processed and approved in accordance with ICD 705.

3. The risk management process includes a critical evaluation of threats, vulnerability, and assets to determine the need and value of countermeasures. The process may include the following:

   a) Threat Analysis. Assess the capabilities, intentions, and opportunity of an adversary to exploit or damage assets or information. For SCI Facilities under Chief of Mission (COM) authority or established on a permanent or temporary basis within or on U.S. diplomatic facilities/compounds, use the Overseas Security Policy Board (OSPB), Security Environment Threat List (SETL) to determine technical threat to a location. When evaluating for TEMPEST, the Certified TEMPEST Technical Authorities (CTTA) shall use the National Security Agency Information Assurance (NSA IA) list as an additional resource for specific technical threat information. *NOTE: These threat documents are classified. Associating the threat level or other threat information with the SCIF location (including country, city, etc.) will normally carry the same classification level identified in the threat document. Ensure that SCIF planning documents and discussions that identify threat with the country or SCIF location are protected accordingly.* It is critical to identify other occupants of common and adjacent buildings. (However, do not attempt to collect information against U.S. persons in violation of Executive Order (EO) 12333.) In areas where there is a diplomatic presence of high and critical technical threat countries, additional countermeasures may be necessary.

b) Vulnerability Analysis. Assess the inherent susceptibility to attack of a procedure, facility, information system, equipment, or policy.

c) Probability Analysis. Assess the probability of an adverse action, incident, or attack occurring.

d) Consequence Analysis. Assess the consequences of such an action (expressed as a measure of loss, such as cost in dollars, resources, programmatic effect/mission impact, etc.).

B. Security in Depth (SID)

1. SID describes the factors that enhance the probability of detection before actual penetration to the SCIF occurs. The existence of a layer or layers of security that offer mitigations for risks may be accepted by the AO. An important factor in determining risk is whether layers of security already exist at the facility. If applied, these layers may, with AO approval, alter construction requirements and extend security alarm response time to the maximum of 15 minutes. Complete documentation of any/all SID measures in place will assist in making risk decisions necessary to render a final standards decision.

2. SID is mandatory for SCIFs located outside the U.S. due to increased threat.

3. The primary means to achieve SID are listed below and are acceptable. SID requires that at least one of the following mitigations is applied:

a) Military installations, embassy compounds, U.S. Government (USG) compounds, or contractor compounds with a dedicated response force of U.S. persons.

b) Controlled buildings with separate building access controls, alarms, elevator controls, stairwell controls, etc., required to gain access to the buildings or elevators. These controls shall be fully coordinated with a formal agreement or managed by the entity that owns the SCIF.

c) Controlled office areas adjacent to or surrounding SCIFs that are protected by alarm equipment installed in accordance with manufacturer's instructions. These controls shall be fully coordinated with a formal agreement or managed by the entity that owns the SCIF.

d) Fenced compounds with access controlled vehicle gate and/or pedestrian gate.

e) The AO may develop additional strategies to mitigate risk and increase probability of detection of unauthorized entry.

C. Compartmented Area (CA)

1. Definition

A CA is an area, room, or a set of rooms within a SCIF that provides controlled separation between control systems, compartments, sub-compartments, or Controlled Access Programs.

2. CA Types

a) Type I CAs are intended for workstation environments that are used to view and process compartmented information. These areas may be comprised of open bays, open spaces, or a set of rooms with multiple cubicles in an accredited SCIF. Within these areas, compartmented information may be securely viewed and/or processed via an approved computer workstation by authorized personnel. Workstations in these environments may include computers with single or multiple monitors. When monitor positioning alone will not adequately protect the material from unauthorized viewing, i.e., shoulder surfing, polarized privacy screens shall be used. Compartmented data shall never be openly displayed on a monitor that faces a primary door or common work area. In addition to processing compartmented information on approved computer workstations, Type I CAs may also include the use of printers, copiers, and scanners if appropriate procedures for control of hard copy material have been established and approved by the AO. No storage or discussion is authorized, logical and/or physical.

b) Type II CAs are areas where discussions of compartmented information may take place. If so equipped and approved, compartmented information may also be viewed and processed. This CA comprises a room, e.g., office or conference room, inside an accredited SCIF where compartmented discussions may be held by authorized personnel. All Type II CAs must meet existing sound transmission class (STC) requirements per ICS 705-1 to ensure that the room or office retains sound within its perimeter. In addition to compartmented discussions, Type II CAs may be used for secure video teleconferencing (SVTC) and related communication conferencing and the use of secure telephones for compartmented discussions. The use of printers, scanners, fax, copiers, and the secure transfer of data to approved removable media require prior approval. No storage is authorized, logical and/or physical.

c) Type III: A restricted discussion area used for viewing, processing, printing, copying, storage and control of accountable compartmented information. This CA is intended for storing and retaining compartmented information when accountability and strict control of compartmented program information is required. This includes, but is not limited to: notes, briefs, slides, electronic presentations, analytic papers, removable hard drives, field packs, thumb drives, laptops, personal electronic devices (PEDs) or hand-held devices that store compartmented information. In addition to the storage of compartmented material in a GSA-approved container, Type III CAs may be used for processing compartmented information on approved computer workstations; the use of printers, scanners, and copiers; the secure transfer of data to approved removable media; the use of secure facsimile machines; and the use of secure telephone equipment (STE) for compartmented discussions. All personnel residing within or who have unfettered access to a Type III CA must be formally briefed into all compartments that reside within the Type III CA. Visitors are permitted within Type III areas only when all compartmented information (for which the visitor is not briefed) is stored within containers, out of sight, and while the visitor is under constant observation by a fully briefed person.

3. Requirements

   a) The CA shall be approved by the AO with the concurrence of the CA Program Manager or designee. The CA Checklist (Chapter 13) shall be used to request approval.

   b) Any construction or security requirements above those listed herein require prior approval from the element head as described in ICS 705-2.

4. Access Control

   a) Access control to the CA may be accomplished by visual recognition or mechanical/electronic access control devices.

   b) Spin-dial combination locks shall not be installed on CA doors.

   c) Independent alarm systems shall not be installed in a CA.

5. Visual Protection of CA Workstations

If compartmented information will be displayed on a computer terminal or group of terminals in an area where everyone is not accessed to the program, the following measures may be applied to reduce the ability of “shoulder surfing” or inadvertent viewing of compartmented information:

- Position the computer screen away from doorway/cubicle opening.
- Use a polarizing privacy screen.
- Use partitions and/or signs.
- Existing private offices or rooms may be used but may not be a mandatory requirement.

6. Closed Storage

When the storage, processing, and use of compartmented information, product, or deliverables is required, and all information shall be stored while not in use, then all of the following shall apply:

a) Access and visual controls identified above shall be the standard safeguard.

b) Compartmented information shall be physically stored in a General Services Administration (GSA) approved safe.

7. Open Storage

In rare instances when open storage of information is required, the following apply:

a) If the parent SCIF is accredited for open storage, a private office with access control on the door is adequate physical security protection.

b) If the parent SCIF has been built and accredited for closed storage, then the CA perimeter shall be constructed and accredited to open storage standards.

c) The CA AO may approve open or closed storage within the CA. Storage requirements shall be noted in both the CA Fixed Facility Checklist (FFC) and, if appropriate, in a Memorandum of Understanding (MOU).

8. Acoustic and Technical Security

a) All TEMPEST, administrative telephone, and technical surveillance countermeasure (TSCM) requirements for the parent SCIF shall apply to the CA and shall be reciprocally accepted.

b) When compartmented discussions are required, the following apply:

(1) Use existing rooms that have been accredited for SCI discussions.

(2) Use administrative procedures to restrict access to the room during conversations.

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Chapter 3. Fixed Facility SCIF Construction

Requirements outlined within this chapter apply to all fixed facility SCIFs. The SCIF Pre-Construction Checklist is found in Chapter 13 and may be completed and sent to the Cognizant Security Authority (CSA) and/or AO as part of the concept approval process. All questions about the checklist content and expected information should be directed to the project CSA/AO. Additional information and requirements for facilities located outside the U.S., its possessions or territories, are found in Chapters 4 and 5. Additional information and requirements for temporary SCIFs are described in Chapter 6.

A. Personnel

Roles and responsibilities of key SCIF construction personnel are identified in ICS 705-1 and restated here for reference.

1. AO Responsibilities

   a) Provide security oversight of all aspects of SCIF construction under their security purview.

   b) Review and approve the design concept, Construction Security Plan (CSP), and final design for each construction project prior to the start of SCIF construction.

   c) Depending on the magnitude of the project, determine if the Site Security Manager (SSM) performs duties on a full-time, principal basis, or as an additional duty to on-site personnel.

   d) Accredit SCIFs under their cognizance.

   e) Prepare waiver requests for the IC element head or designee.

   f) Provide the timely input of all required SCIF data to the IC SCIF repository.

   g) Consider SID on USG or USG-sponsored contractor facilities to substitute for standards herein. (SID shall be documented in the CSP and the FFC.)

2. Site Security Managers (SSMs) Responsibilities

   a) Ensure the requirements herein are implemented and advise the AO of compliance or variances.

   b) In consultation with the AO, develop a CSP regarding implementation of the standards herein. (This document shall include actions required to document the project from start to finish.)

   c) Conduct periodic security inspections for the duration of the project to ensure compliance with the CSP.

   d) Document security violations or deviations from the CSP and notify the AO within 3 business days.

   e) Ensure that procedures to control site access are implemented.

3. CTTA Responsibilities

a) Review SCIF construction or renovation plans to determine if TEMPEST countermeasures are required and recommend solutions. To the maximum extent practicable, TEMPEST mitigation requirements shall be incorporated into the SCIF design.

b) Provide the CSA and AO with documented results of review with recommendations.

4. Construction Surveillance Technicians (CSTs) Responsibilities

a) Supplement site access controls, implement screening and inspection procedures, as well as monitor construction and personnel, when required by the AO.

b) In low and medium technical threat countries, begin surveillance of non-cleared workers at the start of SCIF construction or the installation of major utilities, whichever comes first.

c) In high and critical technical threat countries, begin surveillance of non-cleared workers at the start of: construction of public access or administrative areas adjacent to the SCIF; SCIF construction; or the installation of major utilities, whichever comes first.

B. Construction Security

1. Prior to awarding a construction contract, a CSP for each project shall be developed by the SSM and approved by the AO.

2. Construction plans and all related documents shall be handled and protected in accordance with the CSP.

3. For SCIF renovation projects, barriers shall be installed to segregate construction workers from operational activities and provide protection against unauthorized access and visual observation. Specific guidance shall be contained in the CSP.

4. Periodic security inspections shall be conducted by the SSM or designee for the duration of the project to ensure compliance with construction design and security standards.

5. Construction and design of SCIFs should be performed by U.S. companies using U.S. citizens to reduce risk, but may be performed by U.S. companies using U.S. persons (an individual who has been lawfully admitted for permanent residence as defined in 8 U.S.C. § 1101(a)(20) or who is a protected individual as defined by Title 8 U.S.C. § 1324b (a)(3)). The AO shall ensure mitigations are implemented when using non-U.S. citizens. These mitigations shall be documented in the CSP.

6. All site control measures used shall be documented in the CSP. Among the control measures that may be considered are the following:

- Identity verification.
- Random searches at site entry and exit points.

- Signs at all entry points listing prohibited and restricted items (e.g., cameras, firearms, explosives, drugs, etc.).
- Physical security barriers to deny unauthorized access.
- Vehicle inspections.

C. Perimeter Wall Construction Criteria

1. General

a) SCIF perimeters include all walls that outline the SCIF confines, floors, ceilings, doors, windows and penetrations by ductwork, pipes, and conduit. This section describes recommended methods to meet the standards described within ICS 705-1 for SCIF perimeters.

b) Perimeter wall construction specifications vary by the type of SCIF, location, use of SID, and discussion requirements.

c) Closed storage areas that do not require discussion areas do not have any forced entry or acoustic requirements.

d) Open storage facilities without SID require additional protection against forced and surreptitious entry.

e) When an existing wall is constructed with substantial material (e.g., brick, concrete, cinderblock, etc.) equal to meet the perimeter wall construction standards, the existing wall may be utilized to satisfy the specification.

2. Closed Storage, Secure Working Area (SWA), Continuous Operation, or Open Storage with SID - Use Wall A - Suggested Standard Acoustic Wall (see construction drawing for details).

a) Three layers   inch-thick gypsum wallboard (GWB), one layer on the uncontrolled side of the SCIF and two on the controlled side of the SCIF, to provide adequate rigidity and acoustic protection (Sound Class 3).

b)   allboard shall be attached to 3   inch-wide 16 gauge metal studs or wooden 2 x 4 studs placed no less than 16” on center (o.c.).

c) 16 gauge continuous track (top & bottom) w/ anchors at 32” o.c. maximum) – bed in continuous bead of acoustical sealant.

d) The interior two layers of wallboard shall be mounted so that the seams do not align (i.e., stagger joints).

e) Acoustic fill 3 ½ “ (89mm) sound attenuation material, fastened to prevent sliding down and leaving void at the top.

f) The top and bottom of each wall shall be sealed with an acoustic sealant where it meets the slab.

g) Fire safe non-shrink grout, or acoustic sealant in all voids above/below track both sides of partition.

h) Entire wall assembly shall be finished and painted from true floor to true ceiling.

3. Open Storage without SID -- Use Wall B - Suggested Wall for Expanded Metal or Wall C - Suggested Wall for Plywood.

a) hree layers of inch-thick GWB, one layer on the uncontrolled side of the SCIF and two on the controlled side of the SCIF to provide adequate rigidity and acoustic protection (Sound Class 3).

b) allboard shall be attached to 3 inch-wide 16 gauge metal studs or wooden 2 x 4 studs placed no less than 16” o.c.

c) 16 gauge continuous track (top & bottom) w/ anchors at 32” on center (o.c.) maximum) – bed in continuous bead of acoustical sealant.

d) Wall B - Suggested Wall for Expanded Metal (see drawing for Wall B-Suggested Construction for Expanded Metal).

(1) Three-quarter inch mesh, # 9 (10 gauge) expanded metal shall be affixed to the interior side of all SCIF perimeter wall studs.

(2) Expanded metal shall be spot-welded to the studs every six inches along the length of each vertical stud and at the ceiling and floor.

(3) Hardened screws with one inch washers or hardened clips may be used in lieu of welding to fasten metal to the studs. Screws shall be applied every six inches along the length of each vertical stud and at the ceiling and floor.

(4) Fastening method shall be noted in the FFC.

(5) Entire wall assembly shall be finished and painted from true floor to true ceiling.

e) Wall C - Suggested Wall for Plywood (see drawing for Wall C-Suggested Construction for Plywood).

(1) hree layers of inch-thick GWB, two layers on the uncontrolled side and one layer GWB over minimum ½ ” plywood on the controlled side of the SCIF.

NOTE: CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed in accordance with (IAW) best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the layer of plywood and GWB.

(2) 1/2" Plywood affixed 8’ vertical by 4’ horizontal to 16 gauge studs using glue and #10 steel tapping screws at 12 o.c.

(3) GWB shall be mounted to plywood with screws avoiding contact with studs to mitigate any possible acoustic flanking path.

(4) 16 gauge continuous track (top & bottom) w/ anchors at 32” o.c. maximum) – bed in continuous bead of acoustical sealant.

(5) Fire safe non-shrink grout, or acoustic sealant in all voids above/below track both sides of partition.

(6) Entire wall assembly shall be finished and painted from true floor to true ceiling.

4. Radio Frequency (RF) Protection for Perimeter Walls

a) RF protection shall be installed at the direction of the CTTA when a SCIF utilizes electronic processing and does not provide adequate RF attenuation at the inspectable space boundary. It is recommended for all applications where RF interference from the outside of the SCIF is a concern inside the SCIF.

b) Installation of RF protection should be done using either the drawings or *Best Practices Guidelines for Architectural Radio Frequency Shielding,* prepared by the Technical Requirements Steering Committee under the Center for Security Evaluation. This document is available through the Center for Security Evaluation, Office of the Director of National Intelligence (NCSC/CSE).

5. Vault Construction Criteria

GSA-approved modular vaults meeting Federal Specification AA-V-2737 or one of the following construction methods may be used:

a) Reinforced Concrete Construction

(1) Walls, floor, and ceiling will be a minimum thickness of eight inches of reinforced concrete.

(2) The concrete mixture will have a comprehensive strength rating of at least 2,500 pounds per square inch (psi).

(3) Reinforcing will be accomplished with steel reinforcing rods, a minimum of inches in diameter positioned centralized in the concrete pour and spaced horizontally and vertically six inches on center; rods will be tied or welded at the intersections.

(4) The reinforcing is to be anchored into the ceiling and floor to a minimum depth of one-half the thickness of the adjoining member.

b) Steel-Lined Construction Where Unique Structural Circumstances Do Not Permit Construction of a Concrete Vault

(1) Construction will use ¼ inch-thick steel alloy-type plates having characteristics of high-yield and high-tensile strength.

(2) The steel plates are to be continuously welded to load-bearing steel members of a thickness equal to that of the plates.

(3) If the load-bearing steel members are being placed in a continuous floor and ceiling of reinforced concrete, they must be firmly affixed to a depth of one-half the thickness of the floor and ceiling.

(4) If floor and/or ceiling construction is less than six inches of reinforced concrete, a steel liner is to be constructed the same as the walls to form the floor

and ceiling of the vault. Seams where the steel plates meet horizontally and vertically are to be continuously welded together.

All vaults shall be equipped with a GSA-approved Class 5 vault door.

D. Floor and Ceiling Construction Criteria

1. Floors and ceilings shall be constructed to meet the same standards for force protection and acoustic protection as walls.
2. All floor and ceiling penetrations shall be kept to a minimum.

E. SCIF Door Criteria

1. Door type definitions:
    a) Primary door: A SCIF perimeter door recognized as the main entrance.
    b) Secondary door: A SCIF perimeter door employed as both an entry and egress door that is not the Primary door.
    c) Emergency egress-only door: A SCIF perimeter door employed as an emergency egress door with no entry capability.

2. Primary door criteria:
    a) There shall be only one Primary door to a SCIF.
    b) The Primary door shall be equipped with the following:
        (1) A GSA-approved pedestrian door deadbolt meeting the most current version of Federal Specification FF-L-2890. Previously AO-approved FFL-2740 integrated locking hardware may be used. Additional standalone and flush-mounted dead bolts are prohibited.
        (2) A combination lock meeting the most current version of Federal Specification FFL- 2740. Previously AO-approved combination lock or deadbolt lock type may be used.
        (3) An approved access control device (see Chapter 8). May be equipped with a by-pass keyway for use in the event of an access control system failure.
        (4) Include requirements in E.5 below.
3. **Secondary** door criteria:
    a) Secondary doors may be established with AO approval and as required by building code, safety and accessibility requirements,
        (1) Secondary doors shall:
            (a) Be equipped with a GSA-approved pedestrian door egress device with deadbolt meeting the most current version of Federal Specification FF-L-2890 for secondary door use. An AO-approved

alternate device with similar functionality may be authorized. Additional standalone and flush-mounted deadbolts are prohibited.

(b) Have approved access control hardware (see Chapter 8). The access control system must be deactivated when the SCIF is not occupied, or as determined by the AO.

(c) Include requirements in E.5 below.

4. Emergency Egress-only doors shall:
   a) Be installed as required by building code, safety and accessibility requirements.
   b) Be equipped with GSA-approved pedestrian door emergency egress device with deadbolt configuration meeting the most current version of Federal Specification FF-L-2890 for exit only door use. An AO-approved alternate device with similar functionality and no exterior hardware may be authorized. Additional standalone and flush-mounted deadbolts are prohibited.
   c) Be alarmed 24/7 and have a local audible annunciator that must be activated if the door is opened.
   d) Include requirements in E.5 below.

5. Criteria for **all** SCIF perimeter doors:

   a) All SCIF perimeter doors shall comply with applicable building code, safety, and accessibility requirements as determined by the Authority Having Jurisdiction.

   b) Ensure SCIF Standard Operating Procedures (SOP) includes procedures to ensure all doors are secured at end of day.

   c) All SCIF perimeter pedestrian doors shall be equipped with an automatic, non-hold door-closer which shall be installed internal to the SCIF.

   d) Door hinge pins that are accessible from outside of the SCIF shall be modified to prevent removal of the door, e.g., welded, set screws, dog bolts, etc.

   e) SCIF perimeter doors and frame assemblies shall meet acoustic requirements as described in Chapter 9 unless declared a non-discussion area.

   f) All SCIF perimeter doors shall be alarmed in accordance with Chapter 7.

   g) SCIF Perimeter doors shall meet TEMPEST requirements per CTTA guidance.

   h) When practical and permissible, SCIF entry doors should incorporate a vestibule to preclude visual observation and enhance door acoustic protection.

6. SCIF door fabrication and unique criteria:
   a) Wooden SCIF doors shall be 1 ¾ inch-thick solid wood core (i.e. wood stave, structural composite lumber).
   b) Steel doors shall meet following specifications:
      (1) 1 ¾ inch-thick face steel equal to minimum 18-gauge steel.
      (2) Hinges reinforced to 7-gauge steel and preferably a lift hinge.
      (3) Door closure installation reinforced to 12-gauge steel.

(4) Lock area predrilled and/or reinforced to 10-gauge steel.

c) Vault doors shall not be used to control day access to a facility. To mitigate both security and safety concerns, a vestibule with an access control device may be constructed for the purpose of day access to the vault door.

d) Roll-up Doors shall be minimum 18-gauge steel and shall be secured inside the SCIF using dead-bolts on both the right and left side of the door and alarmed in accordance with Chapter 7.

e) SCIF perimeter Double Door Specifications:

(1) The fixed leaf shall be secured at the top and bottom with deadbolts.

(2) An astragal shall be attached to one door.

(3) Each leaf of the door shall have an independent security alarm contact.

f) Adjacent SCIF adjoining doors:

(1) Doors that join adjacent SCIFs, not required for emergency egress, shall:

(a) Be dead bolted on both sides.

(b) Be alarmed on both sides according to chapter 7.

(c) Meet acoustic requirements as required.

(d) Be covered by AO SOP.

g) Other door types shall be addressed on an individual basis as approved by the AO.

F. SCIF Window Criteria

1. Every effort should be made to minimize or eliminate windows in the SCIF, especially on the ground floor.

2. Windows shall be non-opening.

3. Windows shall be protected by security alarms in accordance with Chapter 7 when they are within 18 feet of the ground or an accessible platform.

4. Windows shall provide visual and acoustic protection.

5. Windows shall be treated to provide RF protection when recommended by the CTTA.

6. All windows less than 18 feet above the ground or from the nearest platform affording access to the window (measured from the bottom of the window), shall be protected against forced entry and meet the standard for the perimeter.

G. SCIF Perimeter Penetrations Criteria

1. All penetrations of perimeter walls shall be kept to a minimum.

2. Metallic penetrations may require TEMPEST countermeasures, to include dielectric breaks or grounding, when recommended by the CTTA.

3. Utilities servicing areas other than the SCIF shall not transit the SCIF unless mitigated with AO approval. This restriction does not apply to secure communication

lines required to transit a SCIF to service an adjacent SCIF through a common perimeter surface.

4. Electrical Utilities should enter the SCIF at a single point.

5. All utility (power and signal) distribution on the interior of a perimeter wall treated for acoustics or RF shall be surface mounted, contained in a raceway, or an additional wall shall be constructed using furring strips as stand-off from the existing wall assembly. If the construction of an additional wall is used gypsum board may be inch-thick and need only go to the false ceiling.

6. Installation of additional conduit penetration for future utility expansion is permissible provided the expansion conduit is filled with acoustic fill and capped (end of pipe cover).

7. Vents and Ducts

a) All vents and ducts shall be protected to meet the acoustic requirements of the SCIF. (See Figure 4, Typical Air (Z) Duct Penetration, for example.)

b) Walls surrounding duct penetrations shall be finished to eliminate any opening between the duct and the wall.

c) All vents or duct openings that penetrate the perimeter walls of a SCIF and exceed 96 square inches shall be protected with permanently affixed bars or grills.

(1) If one dimension of the penetration measures less than six inches, bars or grills are not required.

(2) When metal sound baffles or wave forms are permanently installed and set no farther apart than six inches in one dimension, then bars or grills are not required.

(3) If bars are used, they shall be a minimum of ½ inch diameter steel, welded vertically and horizontally six inches on center; a deviation of ½ inch in vertical and/or horizontal spacing is permissible.

(4) If grilles are used they shall be of:

(a) ¾ inch-mesh, #9 (10 gauge), case-hardened, expanded metal; or

(b) expanded metal diamond mesh, 1-1/2” #10 (1-3/8” by 3” openings, 0.093” thickness, with at least 80% open design) tamperproof; or

(c) welded wire fabric (WWF) 4x4 W2.9xW2.9 (6 gauge smooth steel wire welded vertically and horizontally four inches o.c.).

(5) If bars, grilles, or metal baffles/wave forms are required, an access port shall be installed inside the secure perimeter of the SCIF to allow visual inspection of the bars, grilles, or metal baffles/wave forms. If the area outside the SCIF is controlled (SECRET or equivalent proprietary space), the inspection port may be

installed outside the perimeter of the SCIF and be secured with an AO-approved high-security lock. This shall be noted in the FFC.

H. Alarm Response Time Criteria for SCIFs within the U.S.

Response times for Intrusion Detection Systems (IDS) shall meet 32 CFR Parts 2001 and 2004.

a) Closed Storage response time of 15 minutes.

b) Open Storage response time within 15 minutes of the alarm annunciation if the area is covered by SID or a five minute alarm response time if it is not.

I. Secure Working Areas (SWA)

SWAs are accredited facilities used for discussing, handling, and/or processing SCI, but where SCI will not be stored.

1. The SWA shall be controlled at all times by SCI-indoctrinated individuals or secured with a GSA-approved combination lock.
2. The SCIF shall be alarmed in accordance with Chapter 7 with an initial alarm response time of 15 minutes.
3. Access control shall be in accordance with Chapter 8.
4. Perimeter construction shall comply with section 3.C. above.
5. All SCI used in an SWA shall be removed and stored in GSA-approved security containers within a SCIF, a vault, or be destroyed when the SWA is unoccupied.

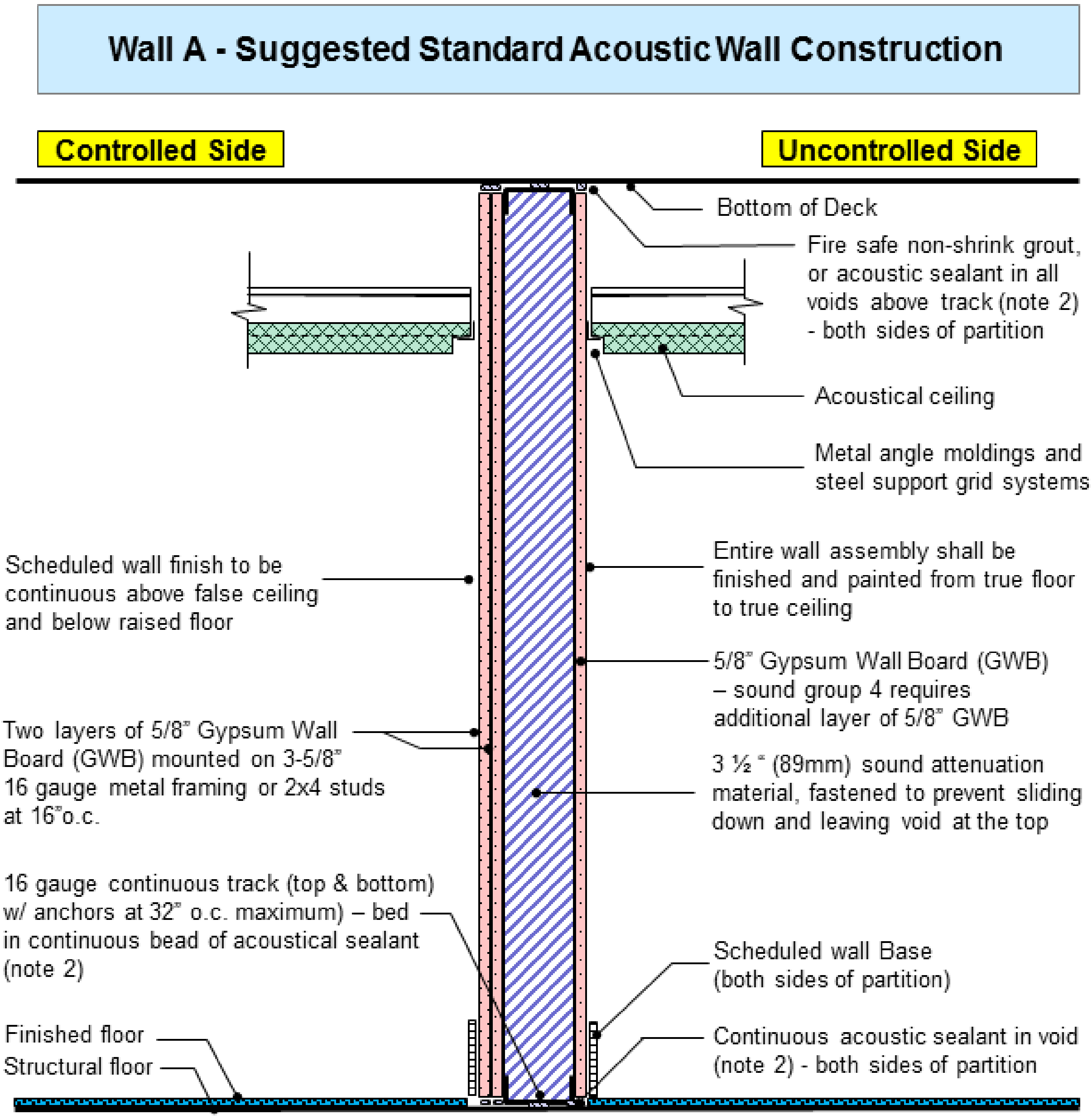
J. Temporary Secure Working Area (TSWA)

TSWAs are accredited facilities where handling, discussing, and/or processing of SCI is limited to less than 40-hours per month and the accreditation is limited to 12 months or less. Extension requests require a plan to accredit as a SCIF or SWA. Storage of SCI is not permitted within a TSWA.

1. When a TSWA is in use at the SCI level, access shall be limited to SCI- indoctrinated persons.
2. The AO may require an alarm system.
3. No special construction is required.
4. When the TSWA is approved for SCI discussions, sound attenuation specifications of Chapter 9 shall be met.
5. The AO may require a TSCM evaluation if the facility has not been continuously controlled at the SECRET level.
6. When the TSWA is not in use at the SCI level, the following shall apply:
    a) The TSWA shall be secured with a high-security, AO-approved key or combination lock.
    b) Access shall be limited to personnel possessing a minimum U.S. SECRET clearance.

Figure 1

Wall A – Suggested Standard Acoustic Wall Construction



Notes:

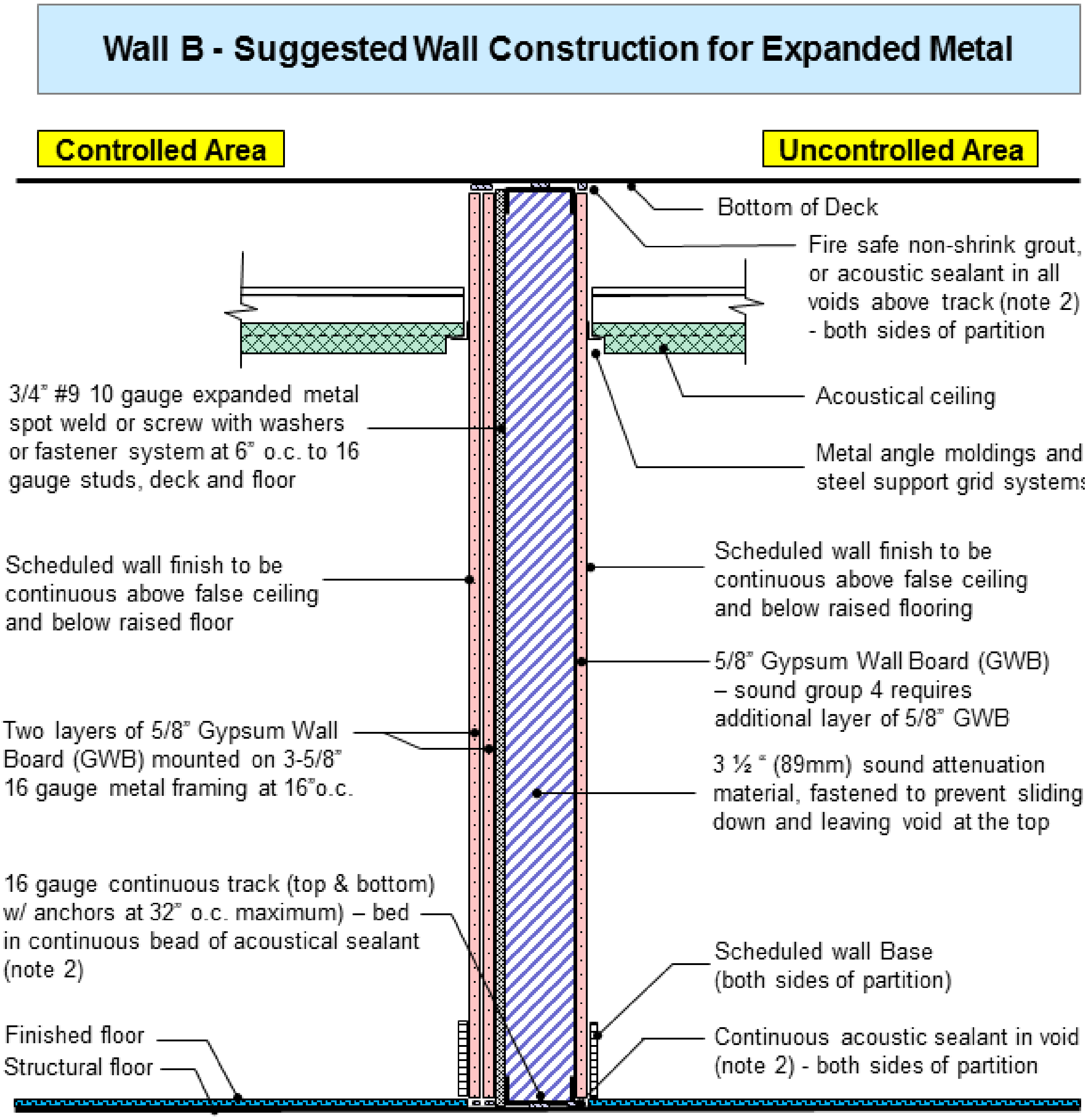
1 CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed IAW best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the two layers of GWB.

2 Partition shall be sealed continuously with acoustical sealant whenever it abuts another element (e.g., wall, column, mullion, etc.)

3 Any electrical or communications outlets required on the perimeter wall shall be surface mounted.

Figure 2

Wall B - Suggested Construction for Expanded Metal



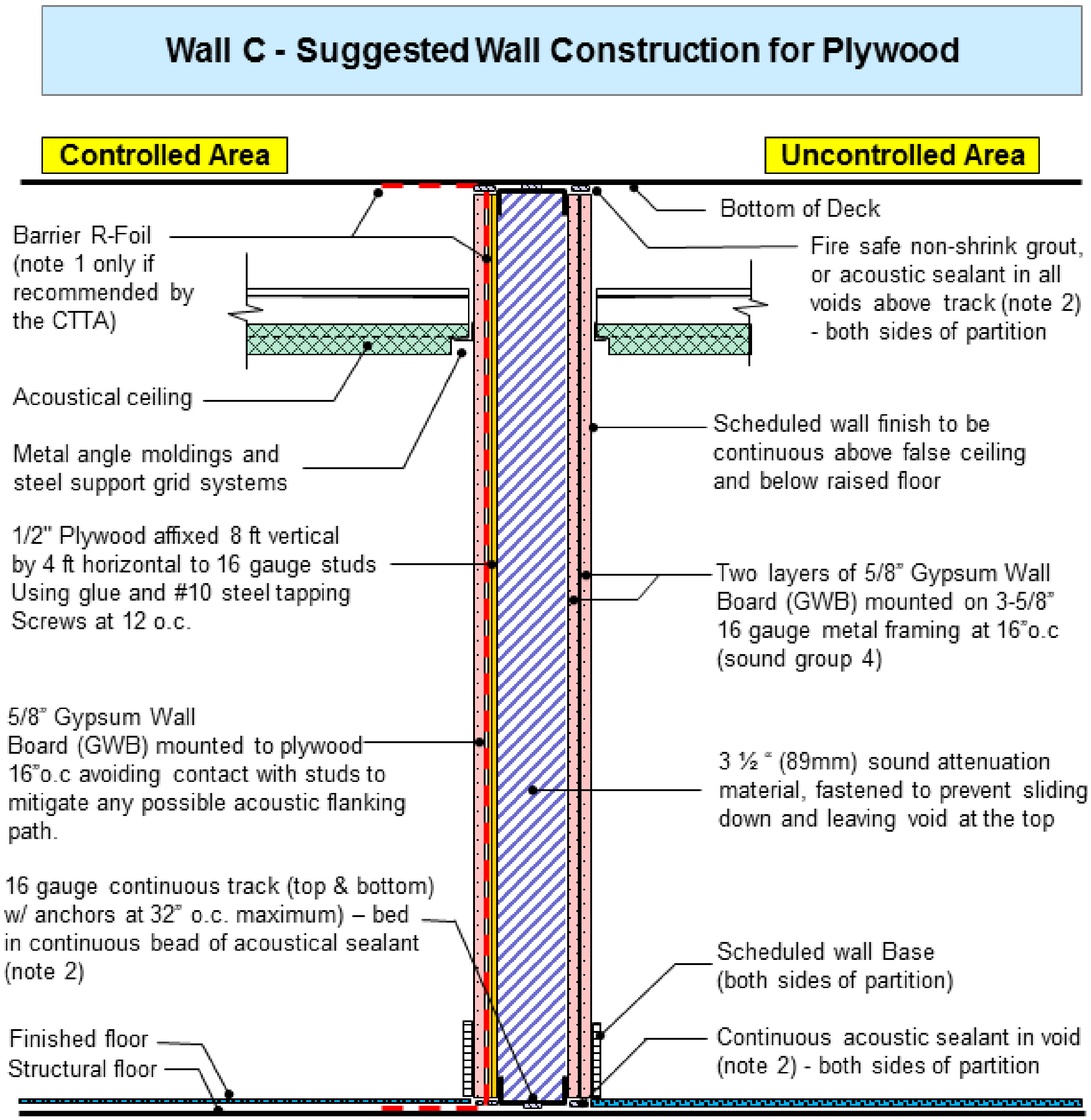
Notes:

1 CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed IAW best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the two layers of GWB.

2 Partition shall be sealed continuously with acoustical sealant whenever it abuts another element (e.g., wall, column, mullion, etc.)

3 Any electrical or communications outlets required on the perimeter wall shall be surface mounted.

Figure 3
Wall C – Suggested Construction for Plywood



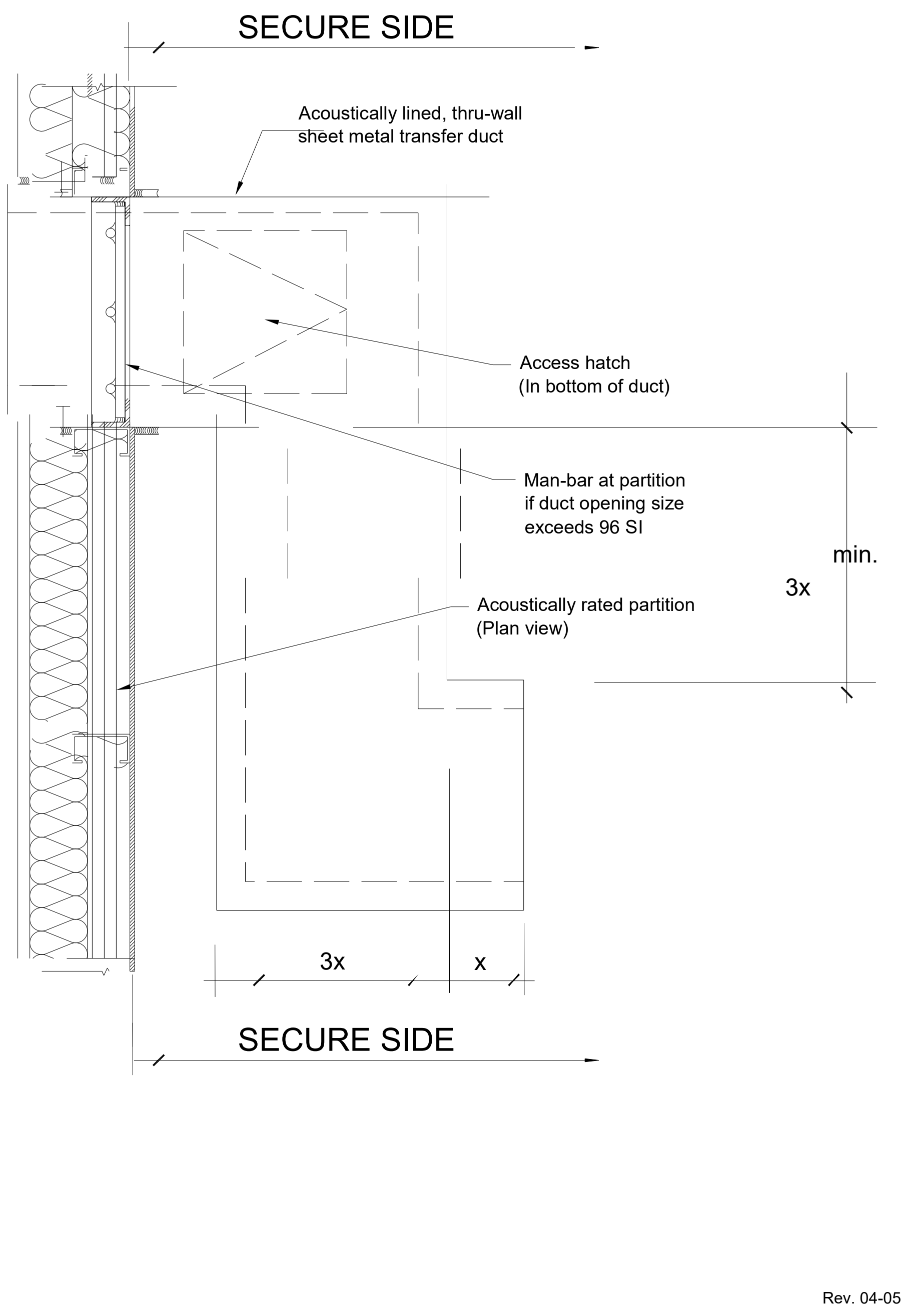
Notes:

1 CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed IAW best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the layer of plywood and GWB.

2 Partition shall be sealed continuously with acoustical sealant whenever it abuts another element (e.g., wall, column, mullion, etc.).

3 Any electrical or communications outlets required on the perimeter wall shall be surface mounted.

Figure 4
Typical Perimeter Air (Z) Duct Penetration



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Chapter 4. SCIFs Outside the U.S. and NOT Under Chief of Mission (COM) Authority

A. General

1. Requirements outlined here apply only to SCIFs located outside of the U.S., its territories and possessions that are not under COM authority.

2. The application and effective use of SID may allow AOs to deviate from this guidance at Category II and III facilities.

B. Establishing Construction Criteria Using Threat Ratings

1. The Department of State's (DoS) Security Environment Threat List (SETL) shall be used in the selection of appropriate construction criteria based on technical threat rating.

2. If the SETL does not have threat information for the city of construction, the SETL threat rating for the closest city within a given country shall apply. When only the capital is noted, it will represent the threat for all SCIF construction within that country.

3. Based on technical threat ratings, building construction has been divided into the following three categories for construction purposes:

- Category I - Critical or High Technical Threat, High Vulnerability Buildings
- Category II - High Technical Threat, Low Vulnerability Buildings
- Category III - Low and Medium Technical Threat

4. Facilities in Category I Areas

a) Open Storage Facilities

(1) Open storage is to be avoided in Category I areas. The head of the IC element shall certify mission essential need and approve on case-by-case basis. When approved, open storage should only be allowed when the host facility is manned 24-hours-per-day by a cleared U.S. presence or the SCIF is continuously occupied by U.S. SCI-indoctrinated personnel.

(2) SCI shall be contained within approved vaults or Class M or greater modular vaults.

(3) The SCIF shall be alarmed in accordance with Chapter 7.

(4) Access control shall be in accordance with Chapter 8.

(5) An alert system and/or duress alarm is recommended.

(6) Initial alarm response time shall be five minutes.

b) Closed Storage Facilities

(1) The SCIF perimeter shall provide five minutes of forced-entry protection. (Refer to Wall B or Wall C construction methods.)

(2) The SCIF shall be alarmed in accordance with Chapter 7.

(3) Access control system shall be in accordance with Chapter 8.

(4) SCI shall be stored in GSA-approved containers or in an area that meets vault construction standards.

(5) Initial alarm response time shall be within 15 minutes.

c) Continuous Operation Facilities

(1) An alert system and duress alarm is required.

(2) The capability shall exist for storage of all SCI in GSA-approved security containers or vault.

(3) The emergency plan shall be tested semi-annually.

(4) Perimeter walls shall comply with enhanced wall construction methods in accordance Wall B or C standards.

(5) The SCIF shall be alarmed in accordance with Chapter 7.

(6) Access control shall be in accordance with Chapter 8.

(7) Initial response time shall be five minutes.

d) SWAs

Construction and use of SWAs is not authorized for facilities in Category I areas because of the significant risk to SCI.

e) TSWAs

Construction and use of TSWAs is not authorized for facilities in Category I areas because of the significant risk to SCI.

5. Facilities in Category II and III Areas

a) Open Storage Facilities

(1) Open storage is to be avoided in Category II areas. The head of the IC element shall certify mission essential need and approve on case-by-case basis. When approved, open storage should only be allowed when the host facility is manned 24-hours-per-day by a cleared U.S. presence or the SCIF is continuously occupied by U.S. SCI-indoctrinated personnel.

(2) In Category III areas, open storage should only be allowed when the host facility is manned 24-hours-per-day by a cleared U.S. presence or the SCIF is continuously occupied by U.S. SCI-indoctrinated personnel.

(3) The SCIF perimeter shall provide five minutes of forced-entry protection. (Refer to Wall B or Wall C construction methods.)

(4) The SCIF shall be alarmed in accordance with Chapter 7.

(5) Access control shall be in accordance with Chapter 8.

(6) An alert system and/or duress alarm is recommended.

(7) Initial alarm response time shall be five minutes.

b) Closed Storage Facilities

(1) The SCIF perimeter shall provide five minutes of forced-entry protection. (Refer to Wall B or Wall C construction methods.)

(2) The SCIF must be alarmed in accordance with Chapter 7.

(3) Access control system shall be in accordance with Chapter 8.

(4) SCI shall be stored in GSA-approved containers.

(5) Initial alarm response time shall be within 15 minutes.

c) Continuous Operation Facilities

(1) Wall A - Standard wall construction shall be utilized.

(2) The SCIF shall be alarmed in accordance with Chapter 7.

(3) Access control shall be in accordance with Chapter 8.

(4) Initial response time shall be five minutes.

(5) An alert system and/or duress alarm is recommended.

(6) The capability shall exist for storage of all SCI in GSA-approved security containers.

(7) The emergency plan shall be tested semi-annually.

d) SWAs

(1) Perimeter walls shall comply with standard Wall A construction.

(2) The SCIF shall be alarmed in accordance with Chapter 7.

(3) Access control shall be in accordance with Chapter 8.

(4) Initial alarm response time shall be within 15 minutes.

(5) The SWA shall be controlled at all times by SCI-indoctrinated individuals or secured with a GSA-approved combination lock.

(6) An alert system and/or duress alarm is recommended.

(7) All SCI used in an SWA shall be removed and stored in GSA-approved security containers within a SCIF or be destroyed.

(8) The emergency plan shall be tested semi-annually.

e) TSWAs

(1) No special construction is required.

(2) The AO may require an alarm system.

(3) When the TSWA is approved for SCI discussions, sound attenuation specifications of Chapter 9 shall be met.

(4) When a TSWA is in use at the SCI level, access shall be limited to SCI-indoctrinated persons.

(5) The AO may require a TSCM evaluation if the facility has not been continuously controlled at the SECRET level.

(6) When a TSWA is **not** in use at the SCI level, the following shall apply:

(a) The TSWA shall be secured with a high security, AO-approved key or combination lock.

(b) Access shall be limited to personnel possessing a U.S. SECRET clearance.

C. Personnel

1. SSM Responsibilities

a) Ensures the security integrity of the construction site (hereafter referred to as the “site”).

b) Develops and implements a CSP.

c) Ensures that the SSM shall have 24-hour unrestricted access to the site (or alternatives shall be stated in CSP).

d) Conducts periodic security inspections for the duration of the project to ensure compliance with the CSP.

e) Documents security violations or deviations from the CSP and notifies the AO.

f) Maintains a list of all workers used on the project; this list shall become part of the facility accreditation files.

g) Implements procedures to deny unauthorized site access.

h) Works with the construction firm(s) to ensure security of the construction site and compliance with the requirements set forth in this document.

i) Notifies the AO if any construction requirements cannot be met.

2. CST Requirements and Responsibilities

a) Possesses U. S. TOP SECRET clearances.

b) Is specially trained in surveillance and the construction trade to deter technical penetrations and thwart implanted technical collection devices.

c) Supplements site access controls, implements screening and inspection procedures, and, when required by the CSP, monitors construction and personnel.

d) Is not required when U.S. TOP SECRET-cleared contractors are used

e) In Category III countries, must do the following:

(1) Shall begin surveillance of non-cleared workers at the start of SCIF construction or the installation of major utilities, whichever comes first.

(2) Upon completion of all work, shall clear and secure the areas for which they are responsible prior to turning control over to the cleared American guards (CAGs).

f) In Category I and II countries, must do the following:

(1) Shall begin surveillance of non-cleared workers at the start of construction of public access or administrative areas adjacent to the SCIF, SCIF construction, or the installation of major utilities, whichever comes first.

(2) Upon completion of all work, shall clear and secure the areas for which the CST is responsible prior to turning over control to the CAGs.

g) On U.S. military installations, when the AO considers the risk acceptable, alternative countermeasures may be substituted for the use of a CST as prescribed in the CSP.

3. CAG Requirements and Responsibilities

a) Possesses a U.S. SECRET clearance (TOP SECRET required under COM authority)

b) Performs access-control functions at all vehicle and pedestrian entrances to the site except as otherwise noted in the CSP.

(1) Screens all non-cleared workers, vehicles, and equipment entering or exiting the site.

(2) Denies introduction of prohibited materials, such as explosives, weapons, electronic devices, or other items as specified by the AO or designee.

(3) Conducts random inspections of site areas to ensure no prohibited materials have been brought on to the site. (All suspicious materials or incidents shall be brought to the attention of the SSM or CST.)

D. Construction Security Requirements

1. Prior to awarding a construction contract, a CSP for each project shall be developed by the SSM and approved by the AO.

2. Construction plans and all related documents shall be handled and protected in accordance with the CSP.

3. For SCIF renovation projects, barriers shall be installed to segregate construction workers from operational activities. These barriers will provide protection against unauthorized access and visual observation. Specific guidance shall be contained in the CSP.

4. When expanding existing SCIF space into areas not controlled at the SECRET level, maximum demolition of the new SCIF area is required.

5. For areas controlled at the SECRET level, or when performing renovations inside existing SCIF space, maximum demolition is not required.

6. All requirements for demolition shall be documented in the CSP.

7. Citizenship and Clearance Requirements for SCIF Construction Personnel

a) Use of workers from countries identified in the SETL as "critical technical threat level" or listed on the DoS Prohibited Countries Matrix is prohibited.

b) General construction of SCIFs shall be performed using U.S. citizens and U.S. firms.

c) SCIF finish work (work that includes closing up wall structures; installing, floating, taping and sealing wallboards; installing trim, chair rail, molding, and floorboards; painting; etc.) in Category III countries shall be accomplished by SECRET-cleared, U.S. personnel.

d) SCIF finish work (work that includes closing up wall structures; installing, floating, taping and sealing wallboards; installing trim, chair rail, molding, and floorboards; painting; etc.) in Category I and II countries shall be accomplished by TOP SECRET-cleared, U.S. personnel.

e) On military facilities, the AO may authorize foreign national citizens or firms to perform general construction of SCIFs. In this situation, the SSM shall prescribe, with AO approval, mitigating strategies to counter security and counterintelligence threats.

f) All non-cleared construction personnel shall provide the SSM with biographical data (full name, current address, Social Security Number (SSN), date and place of birth (DPOB), proof of citizenship, etc.), and fingerprint cards as allowed by local laws prior to the start of construction/renovation.

(1) Two forms of I-9 identification are required to verify U.S. persons.

(2) Whenever host nation agreements or Status of Forces Agreements make this information not available, it shall be addressed in the CSP.

g) When non-U.S. citizens are authorized by the AO:

(1) The SSM shall conduct checks of criminal and subversive files, local, national, and host country agency files, through liaison channels and consistent with host country laws.

(2) Checks shall be conducted of CIA indices through the country's Director of National Intelligence (DNI) representative and appropriate in-theater U.S. military authorities.

h) Access to sites shall be denied or withdrawn if adverse security, Counterintelligence (CI), or criminal activity is revealed. The SSM shall notify the AO when access to the site is denied or withdrawn.

i) For new facilities, the following apply:

(1) Non-cleared workers, monitored by CSTs, may perform the installation of major utilities and feeder lines.

(2) Installation shall be observed at perimeter entry points and when any trenches are being filled.

(3) The number of CSTs shall be determined by the size of the project (square footage and project scope) as outlined in the CSP.

j) For existing facilities, the following apply:

(1) Non-cleared workers, monitored by CSTs or cleared escorts, may perform maximum demolition and debris removal.

(2) TOP SECRET-cleared workers shall be used to renovate or construct SCIF space.

(3) SECRET-cleared individuals may perform the work when escorted by TOP SECRET-cleared personnel.

(4) SCI-indoctrinated escorts are not required when the existing SCIF has been sanitized or a barrier has been constructed to separate the operational areas from the areas identified for construction.

k) Prior to initial access to the site, all construction personnel shall receive a security briefing by the SSM or designee on the security procedures to be followed.

l) If a construction worker leaves the project under unusual circumstances, the SSM shall document the occurrence and notify the AO. The AO shall review for CI concerns.

m) The SSM may require cleared escorts or CSTs for non-cleared workers performing work exterior to the SCIF that may affect SCIF security.

n) The ratio of escort personnel to construction personnel shall be determined by the SSM on a case-by-case basis and documented in the CSP. Prior to assuming escort duties, all escorts shall receive a briefing regarding their responsibilities.

8. Access Control of Construction Sites

a) Access control to the construction site and the use of badges are required.

b) Guards are required for SCIF construction outside the U.S.

c) All site control measures used shall be documented in the CSP. The following are site control measures that should be considered:

- Identity verification.
- Random searches at site entry and exit points.
- Signs, in English and other appropriate languages, at all entry points listing prohibited and restricted items (e.g., cameras, firearms, explosives, drugs, etc.).
- Physical security barriers to deny unauthorized access.
- Vehicle inspections.

d) Guards

(1) Local guards, supervised by CAGs and using procedures established by the AO and documented in the CSP, may search all non-cleared personnel, bags, toolboxes, packages, etc., each time they enter or exit the site.

(2) In Category I countries, CAGs shall be assigned to protect the site and surrounding area as defined in the CSP.

(3) For existing SCIFs, TOP SECRET/SCI-indoctrinated guards are not required to control access to the site or secure storage area (SSA) provided that TOP SECRET/SCI-indoctrinated personnel are present on a 24-hour basis and prescribed post security resources are in place.

(4) Use of non-cleared U.S. guards or non-U.S. guards to control access to the site or SSA requires the prior approval of the AO. A SECRET-cleared, U.S. citizen must supervise any non-cleared or non-U.S. guards. Non-cleared or non-U.S. guards shall not have unescorted access to the site.

E. Procurement of Construction Materials

1. General Standards. These standards apply to construction materials (hereafter referred to as "materials") used in SCIF construction outside the U.S. These standards do not apply to installations on a roof contiguous to the SCIF provided there is no SCIF penetration.

a) Procurements shall be in accordance with Federal Acquisition Regulations.

b) In exceptional circumstances, SSMs may deviate from procurement standards with a waiver; such deviation shall be noted in the CSP.

c) For building construction projects in Category III countries, cleared U.S. citizens may randomly select up to 35% of building materials from non-specific general construction materials for SCIF construction. Random selection may exceed 35% only if materials can be individually inspected.

d) For building construction projects in Category I and II countries, cleared U.S. citizens may randomly select up to 25% of building materials from non-specific general construction materials for SCIF construction. Random selection may exceed 25% only if materials can be individually inspected.

e) Procurement of materials from host or third party countries identified in the SETL as critical for technical intelligence or listed in the DoS Prohibited Countries Matrix is prohibited.

f) All such materials must be selected immediately upon receipt of the shipment and transported to secure storage.

2. Inspectable (e.g., See Chapter 13 Inspectable Materials Checklist) Materials

a) Inspectable materials may be procured from U.S. suppliers without security restrictions.

b) The purchase of inspectable materials from host or third party countries requires advanced approval from the AO.

c) Procurement of materials from host or third party countries identified in the SETL as critical for technical intelligence or listed in the DoS Prohibited Countries Matrix is prohibited.

d) All inspectable materials procured in host and third party countries, or shipped to site in unsecured manner, shall be inspected using an AO-approved method as outlined in the CSP and then moved to an SSA.

e) Random selection of all inspectable material selected from stock stored outside of the SSA shall be inspected using AO-approved methods outlined in the CSP prior to use in SCIF construction.

3. Non-Inspectable Materials

a) Non-inspectable materials may be procured from U.S. suppliers or other AO-approved channels with subsequent secure transportation to the SSA at the construction site.

b) Non-inspectable materials may be procured in a host or third party country if randomly selected by U.S. citizens with a security clearance level approved by the AO.

c) Materials shall be randomly chosen from available suppliers (typically three or more) without advance notice to, or referral from, the selected supplier and without reference of the intended use of material in a SCIF.

d) Selections shall be made from available shelf stock and transported securely to an SSA.

e) Procurement officials should be circumspect about continually purchasing non-inspectable materials from the same local suppliers, and thereby establishing a pattern that could be reasonably discernible by hostile intelligence services, foreign national staff, and suppliers.

F. Secure Transportation for Construction Material

1. Inspectable Materials

a) Secure transportation of inspectable materials is not required, but materials shall be inspected using procedures approved by the AO prior to use.

b) Once inspected, all inspectable materials shall be stored in a SSA prior to use.

c) If securely procured, securely shipped, and stored in a secure environment, inspectable materials may be utilized within the SCIF without inspection.

2. Non-Inspectable Materials

a) Non-inspectable materials include inspectable materials when the site does not possess the capability to inspect them by AO-approved means.

b) Non-inspectable materials shall be securely procured and shipped to site by secure transportation from the U.S., a secure logistics facility, or low threat third party country using one of the following secure methods:

(1) Securely packaged or containerized and under the 24-hour control of an approved courier or escort office. (Escorted shipments shall be considered compromised if physical custody or direct visual observation is lost by the escort officer during transit. Non-inspectable materials that are confirmed or suspected of compromise shall not be used in a SCIF.)

(2) Securely shipped using approved transit security technical safeguards capable of detecting evidence of tampering or compromise. (An unescorted container protected by technical means ("trapped") is considered compromised if evidence of tampering of the protective technology is discovered, or if an unacceptable deviation from the approved transit security plan occurs. Non-inspectable materials that are confirmed or suspected of compromise shall not be used in a SCIF.).

(3) Non-inspectable materials shall be shipped using the following surface and air carriers in order of preference:

- U.S. Military
- U.S. Flag Carriers
- Foreign Flag Carriers

G. Secure Storage of Construction Material

1. A SSA shall be established and maintained for the secure storage of all SCIF construction material and equipment. An SSA is characterized by true floor to true ceiling, slab-to-slab construction of some substantial material, and a solid wood-core or steel-clad door equipped with an AO-approved security lock.

2. All inspected and securely shipped materials shall be placed in the SSA upon arrival and stored there until required for installation.

3. Alternative SSAs may include the following:

a) A shipping container located within a secure perimeter that is locked, alarmed, and monitored.

b) A room or outside location enclosed by a secure perimeter that is under direct observation by a SECRET-cleared U.S. citizen.

4. The SSA shall be under the control of CAGs or other U.S. personnel holding at least U.S. SECRET clearances.

5. Supplemental security requirements for SSAs shall be set forth in the CSP and may vary depending on the location and/or threat to the construction site.

H. Technical Security

1. TEMPEST countermeasures shall be pre-engineered into the construction of the SCIF.

2. In Category I countries, a TSCM inspection shall be required for new SCIF construction or for significant renovations (50% or more of SCIF replacement cost).

3. In Category II and III countries, a TSCM inspection may be required by the AO for new SCIF construction or significant renovations (50% or more of SCIF replacement cost).

4. A TSCM inspection shall be required if uncontrolled space is converted (maximum demolition) to new SCIF space.

5. When a TSCM inspection is not conducted, a mitigation strategy based on a physical security inspection that identifies preventative and corrective countermeasures shall be developed to address any technical security concerns.

I. Interim Accreditations

1. Upon completion of a successful inspection, the respective agency's AO may issue an Interim Accreditation pending receipt of required documentation.

2. If documentation is complete, AOs may issue an Interim Accreditation pending the final inspection.

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Chapter 5. SCIFs Outside the U.S. and Under Chief of Mission Authority

A. Applicability

1. This portion applies to the construction of SCIFs located overseas and that are on any compound that falls under the DoS COM authority or created to support any Tenant Agency that falls under COM authority.

2. The creation of new SCIF space at facilities that fall under COM authority is governed by both ICDs and Overseas Security Policy Board (OSPB) standards published as 12 Foreign Affairs Handbook-6 (12 FAH-6). If there is a conflict between the standards, the more stringent shall apply.

3. For SCIFs constructed in new facilities (new compound or new office building under COM authority), the proponent activity shall coordinate specific requirements for the proposed SCIF with the DoS/Overseas Buildings Operations (OBO).

4. For SCIFs constructed in existing facilities under COM authority, the project proponent activity must coordinate SCIF requirements with DoS/Bureau of Diplomatic Security (DS), the affected Embassy or Consulate (through the Regional Security Officer (RSO) and General Services Officer (GSO)), and DoS/OBO.

5. Upon an upgrade in the SETL Technical Threat rating for a facility under COM authority, the tenant agency in concert with the RSO, shall conduct a survey for OSPB compliance to the new technical threat requirements, and document any compliance issues accordingly. Upgrade requirements shall be coordinated through the RSO, GSO, and DoS/OBO and DS.

6. Temporary SCIFs may only be authorized by exception for facilities under COM authority. The AO of the tenant agency shall notify both the RSO and the DoS AO of the requirement and the expected duration of these facilities. Prior to accreditation, the tenant agency AO must coordinate with the DoS AO.

B. General Guidelines

1. SCIFs located under COM authority outside the U.S. are located within the CAA.

2. Prior to initiating any SCIF implementation process for upgrade or new construction in an existing office building, the tenant agency CSA shall do the following:

   a) Obtain concurrence from the Post‘s Counterintelligence Working Group (CIWG).

   b) Obtain written approval from the COM.

   c) Notify the DoS AO of CWIG and COM approvals.

   d) Coordinate OSPB preliminary survey with the post RSO/Engineering Services Office (ESO) if space is not core CAA.

3. A Preliminary Survey shall be developed by the RSO/ESO and submitted to DoS/DS for review and approval prior to awarding a construction contract. A CSP shall then be developed by the tenant and forwarded to DoS/OBO for processing.

4. All SCIF design, construction, or renovation shall be in compliance with OSPB standards for facilities under COM authority.

5. Any waivers that are granted for a SCIF by a waiver authority that would result in non-compliance with OSPB standards shall require an exception to OSPB standards from DoS/DS.

6. Written approval of the request for an exception to OSPB standards must be received prior to the commencement of any construction projects.

7. Upon completion of construction, the tenant agency AO will accredit the SCIF for SCI operations.

C. Threat Categories

1. The DoS SETL shall be used in the selection of appropriate construction criteria. Based on technical threat ratings, building construction has been divided into three categories for construction purposes:

- Category I - Critical or High Technical Threat, High Vulnerability Buildings
- Category II - High Technical Threat, Low Vulnerability Buildings
- Category III - Low and Medium Technical Threat

2. High and Low Vulnerability Buildings will be determined in accordance with the definitions in the OSPB standards.

3. SCIF design and construction shall comply with the building codes utilized by DoS/OBO.

4. SCIF construction projects are subject to the DoS Construction Security Certification requirements stipulated in Section 160 (a), Public Law 100-204, as amended. Construction activities may not commence until the required certification has been obtained from DoS.

5. SCIF construction projects are subject to permit requirements established by DoS/OBO.

6. Open storage in Category I and II areas is to be avoided. The CSA shall certify mission-essential need and approve on a case-by-case basis.

7. Open storage shall only be allowed for Category III posts when the host facility is manned 24-hours per day by a cleared U.S. presence (i.e., Marine Security Guard).

8. Open storage of SCI material is not authorized in lock-and-leave facilities (i.e., no Marine Security Guard).

D. Construction Requirements

1. Perimeter Wall Construction (all facilities regardless of type or location).

a) Perimeter walls shall comply with enhanced wall construction (See drawings for Walls B and C.)

b) Perimeter shall meet acoustic protection standards unless designated as a non-discussion area.

2. All SCIFs must be alarmed in accordance with Chapter 7.

3. Initial alarm response times shall be within 15 minutes for closed storage and five minutes for open storage.

4. Access control systems shall be in accordance with Chapter 8.

5. SCI shall be stored in GSA-approved containers.

6. An alert system and/or duress alarm is recommended.

7. Continuous Operation Facilities

   a) An alert system and/or duress alarm is recommended.

   b) The capability shall exist for storage of all SCI in GSA-approved security containers.

   c) The emergency plan shall be tested semi-annually.

   d) The SCIF shall be alarmed in accordance with Chapter 7.

   e) Access control shall be in accordance with Chapter 8.

   f) Initial response time shall be five minutes.

8. TSWAs

   a) When a TSWA is in use at the SCI level, the following apply:

      (1) Unescorted access shall be limited to SCI-indoctrinated persons.

      (2) The AO may require an alarm system.

      (3) No special construction is required.

      (4) When the TSWA is approved for SCI discussions the following apply:

         (a) Sound attenuation specifications of Chapter 9 shall be met.
         (b) The AO may require a TSCM evaluation if the facility has not been continuously controlled at the SECRET level.

   b) When the TSWA is **not** in use at the SCI level, the following shall apply:

      (1) The TSWA shall be secured with a DoS/DS-approved key or combination lock.

      (2) Unescorted access shall be limited to personnel possessing a U.S. SECRET clearance.

9. SWA

   a) Initial alarm response times shall be within 15 minutes.

b) The SWA shall be controlled at all times by SCI-indoctrinated individuals or secured with a GSA-approved combination lock.

c) The SWA shall be alarmed in accordance with Chapter 7.

d) Access control shall be in accordance with Chapter 8.

e) Perimeter walls shall comply with standard Wall A.

f) An alert system and/or duress alarm is recommended.

g) All SCI used in a SWA shall be removed and stored in GSA-approved security containers within a SCIF or be destroyed.

h) There shall be an emergency plan that is tested semi-annually.

E. Personnel

1. SSM Requirements and Responsibilities

a) Possesses a U.S. TOP SECRET clearance.

b) Ensures the security integrity of the construction site.

c) Develops and implements a CSP.

d) Shall have 24-hour unrestricted access to the site (or alternatives shall be stated in CSP).

e) Conducts periodic security inspections for the duration of the project to ensure compliance with the CSP.

f) Documents security violations or deviations from the CSP and notifies the RSO and the tenant AO.

g) Maintains a list of all workers utilized on the project; this list shall become part of the facility accreditation files.

h) Implements procedures to deny unauthorized site access.

i) Works with the construction firm(s) to ensure security of the construction site and compliance with the requirements set forth in this document.

j) Notifies the RSO and tenant AO if any construction requirement cannot be met.

2. CST Requirements and Responsibilities

a) Possesses a TOP SECRET clearance.

b) Is specially trained in surveillance and the construction trade to deter technical penetrations and to detect implanted technical collection devices.

c) Supplements site access controls, implements screening and inspection procedures, and when required by the CSP, monitors construction and personnel.

d) Is not required when contractors who are U.S. citizens with U.S. TOP SECRET clearances are used.

e) In Category III countries the following shall apply:

(1) The CST shall begin surveillance of non-cleared workers at the start of SCIF construction.

(2) Upon completion of all work, the CST shall clear and secure the areas for which they are responsible prior to turning control over to the CAGs.

f) In Category I and II countries the following shall apply:

(1) The CST shall begin surveillance of non-cleared workers at the start of construction of public access or administrative areas adjacent to the SCIF, or SCIF construction, whichever comes first.

(2) Upon completion of all work, the CST shall clear and secure the areas for which the CST is responsible prior to turning over control to the CAGs.

3. CAG Requirements and Responsibilities

a) Possesses a U.S. TOP SECRET clearance.

b) Performs access control functions at all vehicle and pedestrian entrances to the site except as otherwise noted in the CSP.

(1) Screens all non-cleared workers, vehicles, and equipment entering or exiting the site.

(2) Uses walk-through and/or hand-held metal detectors or other means approved by the RSO or designee to deny introduction of prohibited materials such as explosives, weapons, electronic devices, or other items as specified by the RSO or designee.

(3) Conducts random inspections of site areas to ensure no prohibited materials have been brought on to the site. All suspicious materials or incidents shall be brought to the attention of the SSM.

c) In Category III countries, CAGs shall be assigned to protect the site and surrounding area at the start of construction of the SCIF or commencement of operations of the SSA.

d) In Category I and II countries, CAGs shall be assigned to protect the site and surrounding area at the start of construction of the SCIF, areas adjacent to the SCIF, or commencement of operations of the SSA.

e) For existing SCIFs, TOP SECRET/SCI-indoctrinated U.S. citizen guards are not required to control access to the site or SSA provided the following apply:

(1) TOP SECRET/SCI-indoctrinated U.S. citizens are present on a 24-hour basis in the SCIF or the SCIF can be properly secured and alarmed.

(2) Prescribed post security resources are in place to monitor the SSA.

F. Construction Security Requirements

1. Prior to awarding a construction contract, a CSP for each project shall be developed by the SSM and approved by DoS/DS and DoS/OBO and the tenant AO.

2. Construction plans and all related documents shall be handled and protected in accordance with the CSP.

3. For SCIF renovation projects, barriers shall be installed to segregate construction workers from operational activities. These barriers will provide protection against unauthorized access and visual observation. Specific guidance shall be contained in the CSP.

4. When expanding existing SCIF space into areas not controlled at the SECRET level, maximum demolition of the new SCIF area is required.

5. For areas controlled at the SECRET level that meet OSPB pre-conditions, or when performing renovations inside existing SCIF space, maximum demolition is not required.

6. All requirements for demolition shall be documented in the CSP.

7. Periodic security inspections shall be conducted by the SSM or designee for the duration of the project to ensure compliance with construction design and security standards.

8. Citizenship and Clearance Requirements for SCIF Construction Personnel

   a) Use of workers from countries identified as critical for Technical or Human Intelligence threat, or listed on the DoS Prohibited Countries Matrix, is prohibited.

   b) General construction and finish work is defined by OSPB standards.

   c) General construction of SCIFs shall be performed using U.S. citizens and U.S. firms. Use of foreign national citizens or firms to perform general construction of SCIFs may be authorized in accordance with OSPB standards. In this situation, the CSP shall prescribe mitigating strategies to counter security and counterintelligence threats.

   d) SCIF finish work shall be accomplished by appropriately cleared personnel as directed by OSPB standards for CAA construction.

   e) All non-cleared construction personnel shall provide the SSM with biographical data (full name, current address, SSN, DPOB, proof of citizenship, etc.), and fingerprint cards as allowed by local laws prior to the start of construction/renovation.

   f) Two forms of I-9 identification are required to verify U.S. persons.

   g) Whenever host nation agreements make this information not available, it shall be addressed in the CSP.

   h) When non-U.S. citizens are authorized, the following shall apply:

      (1) The SSM shall conduct, through liaison channels, checks of criminal and subversive files, local and national; and host country agencies, consistent with host country laws.

      (2) Checks shall also be conducted of CIA indices through the country's DNI representative and appropriate in-theater U.S. military authorities.

(3) Access to sites shall be denied or withdrawn if adverse security, CI, or criminal activity is revealed. The SSM shall notify the AO and RSO when access to the site is denied or withdrawn.

(4) For existing facilities, the following apply:

(a) Non-cleared workers monitored by CSTs may perform maximum demolition for conversion of non-CAA to SCIF. Debris removal by non-cleared workers must be monitored at a minimum by cleared U. S. citizen escorts.

(b) TOP SECRET-cleared U.S. citizens must perform maximum demolition within, or penetrating the perimeter of, an existing SCIF.

(c)TOP SECRET-cleared U.S. citizens shall be used to renovate SCIF space.

(d) SECRET-cleared individuals may perform the work when escorted by TOP SECRET-cleared U.S. citizens.

(e) SCI-indoctrinated escorts are not required when the existing SCIF has been sanitized or a barrier has been constructed to separate the operational areas from the areas identified for construction.

i) Prior to initial access to the site, all construction personnel shall receive a security briefing by the SSM or designee on the security procedures to be followed.

j) If a construction worker leaves the project under unusual circumstances, the SSM shall document the occurrence and notify the RSO and tenant AO. The RSO shall review for CI concerns.

k) The SSM may require cleared escorts or CSTs for non-cleared workers performing work exterior to the SCIF that may affect SCIF security.

l) The ratio of escort personnel to construction personnel shall be determined by the SSM on a case-by-case basis and documented in the CSP. Prior to assuming escort duties, all escorts shall receive a briefing regarding their responsibilities.

9. Access Control of Construction Sites

a) Access control to the construction site and the use of badges are required.

b) Guards are required for SCIF construction outside the U.S.

c) All site control measures used shall be documented in the CSP.

d) The following site control measures should be considered:

(1) Identity verification.

(2) Random searches at site entry and exit points.

(3) Signs, in English and other appropriate languages, at all entry points listing prohibited and restricted items (e.g., cameras, firearms, explosives, drugs, etc.).

(4) Physical security barriers to deny unauthorized access.

(5) Vehicle inspections.

10. Local Guards

a) Local guards, supervised by CAGs and using procedures established by the RSO and documented in the CSP, may search all non-cleared personnel, bags, toolboxes, packages, etc., each time they enter or exit the site.

b) Use of non-cleared U.S. guards or non-U.S. guards to control access to the site or secure storage area (SSA) requires the prior approval of the RSO. A SECRET-cleared U.S. citizen must supervise non-cleared or non-U.S. guards. Non-cleared or non-U.S. guards shall not have unescorted access to the site.

G. Procurement of Construction Materials

1. General Standards

a) These standards apply to construction materials used in SCIF construction under COM authority. These standards do not apply to installations on a roof contiguous to the SCIF provided there is no SCIF penetration.

b) Procurements shall be in accordance with Federal Acquisition Regulations.

c) In exceptional circumstances, SSMs may deviate from procurement standards with a waiver; such deviation shall be noted in the CSP.

d) For building construction projects in Category III countries, cleared U.S. citizens may randomly select up to 35% of building materials from non-specific general construction materials for SCIF construction. Random selection may exceed 35% only if materials can be individually inspected.

e) For building construction projects in Category I and II countries, cleared U.S. citizens may randomly select up to 25% of building materials from non-specific general construction materials for SCIF construction. Random selection may exceed 25% only if materials can be individually inspected.

f) All such materials must be selected immediately upon receipt of the shipment and transported to secure storage.

g) Procurement of materials from host or third party countries identified in the SETL as critical for technical intelligence, or listed on the DoS Prohibited Countries Matrix, is prohibited.

2. Inspectable Materials Specifically Destined for SCIF Construction

a) Inspectable materials specifically destined for SCIF construction may be procured from U.S. third-country or local suppliers without security restrictions.

b) All inspectable materials specifically destined for SCIF construction procured in host and third party countries or shipped to site in an unsecured manner from the U.S. shall be inspected using a DoS/DS-approved method and then moved to an SSA.

c) All inspectable material selected from stock stored outside of the SSA shall be inspected using DoS/DS-approved methods prior to use in SCIF construction.

3. Non-Inspectable Materials Specifically Destined for SCIF Construction

a) Non-inspectable materials specifically destined for SCIF construction shall be procured from U.S. suppliers with subsequent secure transportation to the SSA at the construction site.

b) On an exceptional basis, non-inspectable materials may be procured in a host or third party country if randomly selected by cleared U.S. citizens.

(1) Materials shall be randomly chosen from available suppliers (typically three or more) without advance notice to, or referral from, the selected supplier and with no reference of the intended use of material in a SCIF.

(2) Such selections shall be made from available shelf stock, brought immediately under personal control of a cleared U.S. citizen, and transported securely to an SSA.

(3) Procurement officials should be circumspect about continually purchasing non-inspectable materials from the same local suppliers and establishing a pattern that could be reasonably discernible by hostile intelligence services, foreign national staff, and suppliers.

H. Secure Transportation for Construction Material

1. Inspectable Materials Specifically Destined for SCIF Construction

a) Inspectable materials do not require secure transportation but shall be inspected using procedures approved by the DoS/DS prior to use in the SCIF.

b) Once inspected, all inspectable items shall be stored in an SSA.

c) Materials may be utilized within the SCIF without inspection if securely procured, securely shipped, and stored in a secure environment.

2. Non-inspectable Materials Specifically Destined for SCIF Construction

a) Non-inspectable material includes inspectable materials when the site does not possess the capability to inspect by Do/DS-approved means.

b) Non-inspectable materials shall be securely procured and shipped to site by secure transportation from the U.S., a secure logistics facility, or low threat third party country using one of the following secure methods:

(1) Securely packaged or containerized and under the 24-hour control of an approved courier or escort officer. (Escorted shipments shall be considered compromised if physical custody or direct visual observation is lost by the escort officer during transit. Non-inspectable materials that are confirmed compromised or suspected of compromise shall not be used in a SCIF.)

(2) Securely shipped using approved transit security technical safeguards capable of detecting evidence of tampering or compromise. (An unescorted container protected by technical means ("trapped") is considered compromised if evidence of tampering of the protective technology is discovered, or if an unacceptable deviation from the approved transit security plan occurs. Non-inspectable

materials that are confirmed compromised or suspected of compromise shall not be used in a SCIF.)

(3) Non-inspectable materials shall be shipped using the following surface and air carriers in order of preference:

(a) U.S. Military
(b) U.S. Flag Carriers
(c) Foreign Flag Carriers

I. Secure Storage of Construction Material

1. Upon arrival, all inspected and securely shipped materials shall be placed in the SSA until required for installation.

2. An SSA shall be established and maintained for the secure storage of all SCIF construction material and equipment. It is characterized by true floor to true ceiling, slab-to-slab construction of some substantial material and a solid wood-core or steel-clad door equipped with a DoS/DS-approved security lock.

3. Alternative SSA's may include a shipping container located within a secure perimeter that is locked, alarmed, and monitored, or a room or outside location enclosed by a secure perimeter that is under direct observation by a SECRET-cleared U.S. citizen.

4. The SSA shall be under the control of CAGs or other U.S. citizens holding at least U.S. SECRET clearances.

5. Supplemental security requirements for SSAs shall be set forth in the CSP and may vary depending on the location and/or threat to the construction site.

J. Technical Security

1. TEMPEST countermeasures shall be pre-engineered into the building.

2. A TSCM inspection shall be required in Category I countries for new SCIF construction or significant renovations (50% or more of SCIF replacement cost).

3. A TSCM inspection may be required by the AO in Category II or III countries for new SCIF construction or significant renovations (50% or more of SCIF replacement cost).

4. A TSCM inspection, conducted at the completion of construction, shall be required if uncontrolled space is converted (maximum demolition) to new SCIF space.

5. When a TSCM inspection is not conducted, a mitigation strategy based on a physical security inspection that identifies preventative and corrective countermeasures shall be developed to address any technical security concerns.

K. Interim Accreditations

1. Upon completion of a successful inspection, the respective agency's AO may issue an Interim Accreditation pending receipt of required documentation.

2. If documentation is complete, AOs may issue an Interim Accreditation pending the final inspection.

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Chapter 6. Temporary, Airborne, and Shipboard SCIFs

A. Applicability

1. General Information

a) This chapter covers all SCIFs designed to be temporary or such as those at sites for contingency operations, emergency operations, and tactical military operations. This chapter does not apply to temporary SCIFs established or operated within or on U.S. diplomatic facilities/compounds; see Chapter 5 for applicable guidance.

b) These standards apply to the following:

(1) All ground-based temporary SCIFs (T-SCIFs), including those on mobile platforms (e.g., trucks and trailers).

(2) SCIFs aboard aircraft.

(3) SCIFs aboard surface and sub-surface vessels.

c) When employing T-SCIFs, a risk management approach shall be used that balances the operational mission and the protection of SCI.

2. Accreditation

a) Accreditation for the use of T-SCIFs shall not exceed one year without mission justification and approval by the AO.

b) When the T-SCIF owner determines that a T-SCIF is no longer required, the withdrawal of accreditation shall be initiated by the SSO/Contractor Special Security Officer (CSSO).

(1) Upon notification, the AO will issue appropriate SCI withdrawal correspondence.

(2) The AO or appointed representative will conduct a close-out inspection of the facility to ensure that all SCI material has been removed.

B. Ground-Based T-SCIFs

1. T-SCIF Structures and Activation

a) Ground-based T-SCIFs may be established in hardened structures (e.g., buildings, bunkers) or semi-permanent structures (e.g., truck-mounted or towed military shelters, prefabricated buildings, tents).

b) Permanent-type hardened structures shall be used to the greatest extent possible for T-SCIFs.

c) Prior to T-SCIF activation, the AO may require submission of a standard fixed facility checklist or a T-SCIF checklist produced before or after a deployment.

2. SCI Storage and Destruction

a) Under field or combat conditions, open storage of SCI media and materials requires a continuous presence by SCI-indoctrinated personnel.

b) Under field or combat conditions every effort shall be made to obtain from any available host command necessary support for the storage and protection of SCI (e.g., security containers, generators, guards, weapons, etc.).

c) The quantity of SCI material within a T-SCIF shall be limited, to the extent possible, to an amount consistent with operational needs.

d) All SCI shall be stored in GSA-approved security containers.

e) The AO may approve exceptions to the storage of SCI material in GSA-approved storage containers for a specified period of time.

f) When no longer needed, SCI material shall be destroyed by means approved by the AO.

3. Security Requirements

a) T-SCIF security features shall provide acoustical, visual, and surreptitious entry protection.

b) A TSCM inspection shall be requested for any structure proposed for T-SCIF use if the space was previously occupied by a non-U.S. element. It is the AO's responsibility to evaluate operating the SCIF prior to TSCM inspection and formally assume all risk associated with early operation.

c) When possible, T-SCIFs shall be established within the perimeters of U.S.-controlled areas or compounds.

d) If a U.S.-controlled area or compound is not available, the T-SCIF shall be located within an area that affords the greatest degree of protection against surreptitious or forced entry.

e) When a T-SCIF is in operation, the perimeter of its immediate area shall be observed and protected by U.S. guards with U.S. SECRET clearances. Guards shall be equipped with emergency communication devices and, if necessary, with weapons.

f) During non-operational hours, the T-SCIF shall be provided security protection in accordance with AO guidelines.

g) The T-SCIF shall have only one entrance which shall be controlled during hours of operation by an SCI-indoctrinated person using an access roster.

h) Unclassified telecommunications equipment shall meet the requirements outlined in Chapter 10 to the greatest extent practical.

i) Telephones obtained in a foreign country shall not be used within a T-SCIF.

j) Cables and wires penetrating the T-SCIF perimeter shall be protected. The AO may require inspections and routing of cables and wiring through protective distribution systems or may require other countermeasures.

k) AO-approved emergency destruction and evacuation plans shall be developed and rehearsed periodically by all personnel assigned to the T-SCIF; the results of the rehearsal drills shall be documented.

l) When in transit, ground-based and mobile (e.g., truck-mounted, towed military shelters) T-SCIFs containing unsecured and non-encrypted SCI shall be accompanied by a U.S. TOP SECRET-cleared individual with SCI access approval(s).

m) During movement, T-SCIF structures shall be secured with GSA-approved locking devices and equipped with tamper-evident seals.

n) When in transit, hardened T-SCIFs having no open storage of SCI may be monitored by a U.S SECRET-cleared individual.

o) Hardened T-SCIFs shall be designed with TEMPEST countermeasures as identified by the CTTA. The AO, in collaboration with the CTTA, shall provide red/black separation and "protected distribution" guidance for field installation in accordance with CNSSAM TEMPEST 1/13 and CNSSI 7003.

p) When a T-SCIF is no longer required, the responsible SCI security official shall conduct a thorough facility inspection to ensure all SCI material has been removed.

C. Permanent and Tactical SCIFs Aboard Aircraft

1. The Aircraft Facility Checklist (see Forms & Plans) will be used for permanent SCIFs aboard aircraft.

2. The AO may determine that an Aircraft Facility Checklist may not be required for tactical SCIFs aboard aircraft if the following information is provided:

a) Name of aircraft (tail number)/airborne T-SCIF.

b) Major command/organization.

c) ID number of parent SCIF, if applicable.

d) Location T-SCIF deployed from and date of deployment.

e) Location T-SCIF deployed to and date of deployment.

f) SCI compartment(s) involved in T-SCIF operations.

g) Time period for T-SCIF operations.

h) Name of exercise or operation.

i) Points of contact (responsible officers).

j) Type of aircraft and area to be accredited as a T-SCIF.

k) Description of security measures for entire period of T-SCIF use (standard operating procedures).

l) Additional comments to add clarification.

3. Security Requirements for Aircraft when Operating in Support of Missions Involving SCI Material

a) SCIF location shall be identified by aircraft tail number.

b) Access to the aircraft interior shall be controlled at all times by SCI-indoctrinated personnel.

c) There are no unique physical security construction standards for SCIFs aboard aircraft.

d) Accreditation, such as that from the Defense Courier Service, is not required for aircraft used solely to transport SCI material between airfields.

e) When all personnel on an aircraft are not briefed on every SCI compartment aboard, procedural methods or physical barriers shall be employed to isolate compartments of the SCI.

f) When an aircraft T-SCIF is no longer required, the responsible SCI security official shall conduct an inspection of the aircraft to ensure all SCI material has been removed.

4. SCI Storage and Destruction

a) SCI materials shall be encrypted or secured in an AO-approved security container.

b) When no longer needed, SCI materials shall be destroyed by means approved by the AO.

c) Following an unscheduled landing in U.S.-controlled or non-hostile territory, the senior SCI-indoctrinated person shall retain control of the SCI material until approved storage arrangements can be effected through a local Special Security Officer or SCI-indoctrinated official.

d) Prior to an unscheduled landing in unfriendly or hostile territory, every reasonable effort shall be made to destroy unencrypted SCI material and communications security equipment in accordance with the emergency destruction plan.

e) If the aircraft is stationary, in the absence of SCI-indoctrinated personnel, all SCI information shall be encrypted or removed and stored in an alternative accredited SCIF or location approved by the AO.

f) Emergency destruction plans for SCI material shall be developed, approved by the AO, and rehearsed periodically by all personnel assigned to the aircraft; rehearsal results shall be documented.

5. Additional Security Requirements for Stationary Aircraft

a) The aircraft shall be parked within a controlled area that affords the greatest protection against surreptitious or forced entry.

b) In the absence of SCI-indoctrinated personnel, all SCI information shall be encrypted or removed and stored in an alternative accredited SCIF or location approved by the AO.

c) If the aircraft cannot be positioned within a U.S.-controlled area, the SCI is not encrypted, and removal of the SCI is not possible, then the following measures must be taken:

(1) SCI-indoctrinated personnel shall remain with the aircraft.

(2) A guard force that can control the perimeter of the aircraft shall be deployed, unless infeasible. The guards shall possess U.S. SECRET clearances and be armed and equipped with emergency communication devices.

d) If the aircraft is located within a U.S.-controlled area, the SCI is not encrypted, and removal of SCI is not possible then, the following measures shall be taken:

(1) The AO may mitigate the requirement for SCI-indoctrinated personnel provided the aircraft is equipped with, or stored within a structure equipped with, an intrusion detection system approved by the AO.

(2) All aircraft hatches and doors shall be secured with AO-approved locks and tamper-evident seals.

(3) A guard force must be available to respond to an alarm within five minutes.

(4) Guards shall possess U.S. SECRET clearances and be armed and equipped with emergency communication devices.

(5) If a cleared U.S. guard force is not available, the AO may approve other mitigation measures.

D. Permanent and Tactical SCIFs on Surface or Subsurface Vessels

1. Permanent shipboard SCIFs shall consist of any area aboard a vessel where SCI is processed, stored, or discussed.

2. The Shipboard Checklist (see Forms & Plans) will be used for permanent SCIFs. The AO may determine that this checklist may not be required providing the below information is available:

a) Name of vessel/hull number.

b) Major command/organization.

c) ID number of parent SCIF, if applicable.

d) Location SCIF deployed from and date of deployment.

e) Location SCIF deployed to and date of deployment.

f) SCI compartment(s) and sub-compartments involved in SCIF operations.

g) Name of exercise or operation.

h) Points of contact (responsible officers).

i) Description of security measures for entire period of SCIF use (standard operating procedures).

j) Additional comments to add clarification.

3. Security Requirements for Permanent SCIFs

a) The perimeter (walls, floors, and ceiling) shall be fabricated of structural bulkheads comprised of standard shipboard/submarine construction materials.

b) Elements of the perimeter shall be fully braced and welded or bonded in place.

c) Doors shall conform to the following requirements:

(1) Perimeter doors and emergency exit(s) shall be constructed of standard shipboard materials and shall be mounted in a frame, braced and welded or bonded in place in a manner commensurate with the structural characteristics of the bulkhead, deck, or overhead.

(2) The primary entry door shall be equipped with a GSA-approved combination lock and an access control device.

(3) If the door is in a bulkhead that is part of an airtight perimeter, the airtight integrity may be maintained by co-locating the door with the metal joiner door, or by adding a vestibule.

(4) Metal joiner doors shall be equipped with a combination lock that meets specification FF-L-2740A and with an access control device approved by the AO.

(5) Doors shall be constructed in a manner that will preclude unauthorized removal of hinge pins and anchor bolts, and obstruct access to lock-in bolts between the door and frame.

(6) Doorways or similar openings that allow visual access to the SCIF shall be screened or curtained.

d) No damage control fittings or cables shall be located within, or pass through, the SCIF. This does not apply to smoke dampers or other life-safety devices that are operated by personnel within the space during working hours.

e) Removable hatches and deck plates less than 10 square feet that are secured by exposed nuts and bolts (external to the SCIF) shall be secured with a high security padlock (unless their weight makes this unreasonable). Padlock keys shall be stored in a security container located within the SCIF.

f) Vents, ducts, and similar openings with a cross-sectional measurement greater than 96 inches shall be protected by a fixed barrier or security grill. (This requirement is not applicable to through-ducts that do not open into the SCIF.)

(1) Grills shall be fabricated of steel or aluminum grating or bars with a thickness equal to the perimeter barrier.

(2) If a grating is used, bridge center-to-center measurements will not exceed 1.5 inches by 4 inches.

(3) Bars shall be mounted in a grid pattern, six-inches on center.

(4) The grating or bars shall be welded into place.

g) Construction of the SCIF perimeter shall afford adequate sound attenuation. Air handling units and ducts may require baffles if SCIF discussions can be overhead in adjacent areas.

h) The SCIF shall be equipped with an AO-approved intrusion detection system (IDS) or other countermeasures if SCI-indoctrinated personnel cannot continuously occupy the area.

i) Passing scuttles and windows should not be installed between the SCIF and any other space on the ship. If installed, they shall be secured on the inside of the SCIF.

j) All SCI cryptographic and processing equipment shall be located within the SCIF.

k) Unclassified telecommunications shall meet the requirements outlined in Chapter 11, to the greatest extent practical.

l) Sound-powered telephones will not be permitted in the SCIF without additional mitigations determined by the AO. If a deviation is granted, sound-powered telephones located within the SCIF and connecting to locations outside the SCIF shall comply with the following:

(1) Telephone cables shall not break out to jack-boxes, switchboards, or telephone sets other than at designated stations. Cables shall not be shared with any circuit other than call or signal systems associated with the SCIF circuit.

(2) Telephone cables shall be equipped with a selector switch located at the controlling station and shall be capable of disconnecting all stations, selecting any one station, and disconnecting the remaining stations.

(3) Sound-powered telephones not equipped with a selector switch shall have a positive disconnect device attached to the telephone circuit.

(4) Within any SCIF, sound-powered telephones not used for passing SCI information shall have a warning sign prominently affixed indicating the restriction.

(5) A call or signal system shall be provided. Call signal station, type ID/D, shall provide an in-line disconnect to prevent a loudspeaker from functioning as a microphone.

m) The approval of the AO is required for unencrypted, internal, communication-announcing systems that pass through the SCIF perimeter.

n) Intercommunications-type announcing systems installed within an SCIF shall meet the following standards:

(1) The system shall operate only in the push-to-talk mode.

(2) Receive elements shall be equipped with a local buffer amplifier to prevent loudspeakers or earphones from functioning as microphones.

(3) Except as specified, radio transmission capability for plain radio-telephone (excluding secure voice) will not be connected.

(4) Cable conductors assigned to the transmission of plain language radio-telephone will be connected to ground at each end of the cable.

(5) A warning sign will be posted that indicates the system may not be used to pass SCI.

(6) Unencrypted internal communication systems that pass through the SCIF perimeter shall be in grounded ferrous conduit.

o) Commercial intercommunication equipment shall not be installed within a SCIF without prior AO approval.

p) Loudspeakers used on general announcing systems shall be equipped with a one-way buffer amplifier to protect against microphonic responses.

q) Pneumatic tube systems shall not be installed within the SCIF. The following safeguards apply to existing systems on older ships:

(1) Covers shall be locked at both ends with an AO-approved lock. Keys shall be stored within an approved security container within the SCIF.

(2) The system shall have the capability to maintain the pressure or vacuum and the capability to lock in the secure position at the initiating end.

(3) There shall be a direct voice communications link between both ends to confirm the transportation and receipt of passing cartridges.

(4) Cartridges passing SCI material shall have a distinctive color.

(5) Pneumatic tubes shall be visually inspectable along their entire length.

(6) The CTTA shall conduct a TEMPEST countermeasures inspection and shall recommend safeguards to limit compromising emanations. TEMPEST safeguards should be pre-engineered into platforms to the greatest extent possible.

4. General Requirements for T-SCIFs

a) SCIFs on sub-surface vessels shall be accredited as T-SCIFs.

b) T-SCIFs aboard a vessel include portable platforms or containers temporarily placed within ship space such as embarked Portable Shipboard Collection Vans.

c) T-SCIFs shall be occupied by an SCI-indoctrinated person at all times unless the facility is protected by a GSA-approved lock, an approved intrusion detection system, and a response capability or other countermeasures approved by the AO.

5. Security Requirements for T-SCIFs

a) Overall T-SCIF construction standards shall be the same as those used for permanent shipboard SCIFs.

b) Vents, ducts, and similar openings shall be constructed to the same standards as those used for a shipboard SCIF.

c) SCI materials shall be destroyed by means approved by the AO when no longer needed.

d) AO-approved emergency destruction plans shall be rehearsed periodically by all personnel assigned to the T-SCIF and the rehearsals documented.

e) Unclassified telecommunications shall meet the requirements for a shipboard SCIF, to the greatest extent practical.

f) When the T-SCIF is no longer required, the responsible SCI security official shall conduct a closing inspection of the T-SCIF to ensure all SCI material has been removed.

g) The CTTA shall conduct a TEMPEST countermeasures inspection and shall recommend safeguards to limit compromising emanations. TEMPEST safeguards should be pre-engineered into platforms to the greatest extent possible.

6. Additional Security Standards for Mobile Platforms or Containers

a) Construction of the perimeter must be of sufficient strength to reveal evidence of physical penetration (except for required antenna cables and power lines).

b) Doors must fit securely and be equipped with a locking device that can be locked from the inside and outside.

7. SCI Storage and Destruction

a) SCI material shall be stored in a GSA-approved security container that is welded or otherwise permanently secured to the structural deck.

b) When no longer needed, SCI materials shall be destroyed by means approved by the AO.

c) AO-approved emergency destruction and evacuation plans shall be developed and rehearsed periodically by all personnel assigned to the SCIF and the rehearsals shall be documented.

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Chapter 7. Intrusion Detection Systems (IDS)

A. Specifications and Implementation Requirements

1. General SCIF IDS Requirements

a) SCIFs shall be protected by IDS when not occupied.

b) Interior areas of a SCIF through which reasonable access could be gained, including walls common to areas not protected at the SCI level, shall be protected by IDS. However, these adjacent areas do not need IDS protection if the AO determines that a facility's security programs consist of layered and complementary controls sufficient to deter and detect unauthorized entry and movement.

c) Doors without access control systems and that are not under constant visual observation shall be continuously monitored by the IDS.

d) If any component of the IDS is disrupted to the extent the system no longer provides essential monitoring service (e.g., loss of line security, inoperable Intrusion Detection Equipment (IDE), or loss of power), SCI-indoctrinated personnel shall physically occupy the SCIF until the system is returned to normal operation. As an alternative, the outside SCIF perimeter may be continuously monitored by a response or guard force.

e) IDS failure shall be addressed in the SCIF emergency plan.

2. System Requirements

a) IDS installation related components and monitoring stations shall comply with Underwriters Laboratories (UL) Standard for National Industrial Security Systems for the Protection of Classified Material, UL 2050.

b) Installation shall comply with an Extent 3 installation as referenced in UL 2050.

c) Systems developed and used exclusively by the USG do not require UL certification, but shall nonetheless comply with an Extent 3 installation as referenced in UL 2050.

d) Areas of a SCIF through which reasonable access could be gained, including walls common to areas not protected at the SCI level, shall be protected by IDS consisting of UL 639 listed motion sensors and UL 634 listed High Security Switches (HSS) that meet UL Level II requirements and/or other AO-approved equivalent sensors. All new SCIF accreditations shall use UL Level II HSS. Existing UL Level I HSS are authorized until major IDS modifications/upgrades are made.

e) IDE cabling that extends beyond the SCIF perimeter shall employ Encrypted Line Security or be installed in a closed and sealed metal conveyance defined as a pipe, tube or the like constructed of ferrous Electrical Metallic Tubing (EMT), ferrous pipe conduit or ferrous rigid sheet metal ducting. All joints and connections shall be permanently sealed completely around all surfaces (e.g. welding, epoxy, fusion, etc.). Set screw shall not be used. The seal shall provide a continuous bond between the components of the conveyance. If a service or pull box must be utilized, it must be secured with a GSA approved combination padlock or AO approved key lock.

f) SCIFs that share common or contiguous perimeter and support the same IC Element, or have an established Co-Use-Agreement (CUA), may have the Premise Control Unit (PCU) programmed into multiple logical units or partitions, of the same PCU, that function as individual control units for the intrusion detection system installed in multiple areas or rooms operated independently of one another. All conditions of compliance that apply to a PCU and IDS apply equally to the partitions of the PCU. The PCU shall be independent of IDS safeguarding non-UL 2050 certified areas.

g) If a monitoring station is responsible for more than one IDS, there shall be an audible and visible annunciation for each IDS.

h) IDS's shall be separate from, and independent of, fire, smoke, radon, water, and other systems.

i) If the IDS incorporates an access control system (ACS), notifications from the ACS shall be subordinate in priority to IDS alarms.

j) System key variables and passwords shall be protected and restricted to U.S. SCI-indoctrinated personnel.

k) IDS technical drawings, installation instructions, specifications, etc., shall be restricted as determined by the AO and documented in the CSP.

l) Systems shall not include audio or video monitoring without the application of appropriate countermeasures and AO approval.

m) Monitoring systems containing auto-reset features shall have this feature disabled.

n) Alarm activations shall remain displayed locally until cleared by an authorized SCI-cleared individual.

o) The AO shall approve all system plans. Final system acceptance testing shall be included as part of the SCIF accreditation package.

p) False alarms shall not exceed one alarm per 30-day period per IDS partition. False alarms are any alarm signal transmitted in the absence of a confirmed intrusion that is caused by changes in the environment, equipment malfunction or electrical disturbances. If false alarms exceed this requirement, a technical evaluation of the system shall be conducted to determine the cause, repaired or resolved, and documented.

3. System Components

a) Sensors

(1) All system sensors shall be located within the SCIF, except as noted in 3.a.(2) below.

(2) With AO approval, sensors external to the SCIF perimeter may be installed in accordance with paragraph A.2.e.

(3) Failed sensors shall cause immediate and continuous alarm activation until the failure is investigated and corrected by procedures as documented in the SCIF SOP or Emergency Action Plan.

(4) Dual technology sensors are authorized when each technology transmits alarm conditions independent of the other technology.

(5) A sufficient number of motion detection sensors shall be installed to meet the requirements of paragraph A.2.d or shall be approved by the AO. However, for facilities outside the U.S. and in Category I and II countries, motion detection sensors above false ceilings or below false floors may be required by the AO.

(6) When the primary entrance door employs a delay to allow for changing the system mode of access, the delay shall not exceed 30 seconds.

(7) SCIF perimeter doors shall be protected by an HSS and a motion detection sensor.

(8) Emergency exit doors shall be alarmed and monitored 24 hours per day.

b) Premise Control Units (PCUs)

(1) PCUs shall be located within a SCIF and only SCIF personnel may initiate changes in access modes.

(2) Operation of the access/secure switch shall be restricted by using a device or procedure that validates authorized use.

(3) Cabling between all sensors and the PCU shall be dedicated to the system, be contained within the SCIF, and shall comply with national and local electric codes and Committee for National Security Systems (CNSS) standards. If the wiring cannot be contained within the SCIF, such cabling shall meet the requirements for External Transmission Line Security 3.b.(10) below.

(4) Alarm status shall be continuously displayed with an alphanumeric display at the PCU and/or monitoring station.

(5) Every effort shall be made to design and install the alarm-monitoring panel in a location that prevents observation by unauthorized persons.

(6) The monitoring station or PCU shall identify and display activated sensors.

(7) Immediate and continuous alarm annunciations shall occur for the following conditions.

(a) Intrusion Detection
(b) Failed Sensor
(c) Tamper Detection
(d) Maintenance Mode (a maintenance message displayed in place of an alarm)
(e) IDE Sensor Points shunted or masked during maintenance mode

(8) A change in power status (AC or backup) shall be indicated locally and at the monitoring station.

(9) All system events shall be reset by authorized SCI-indoctrinated personnel after an inspection of the SCIF and a determination for the cause of the alarm. Any auto-alarm reset feature of the IDS shall be disabled.

(10) IDS transmission lines leaving the SCIF to the monitoring station, must meet National Institute of Standards and Technology, Federal Information Processing Standards (FIPS) for certified encrypted lines. The FIPS standard employed must be noted on the UL 2050/CRZH Certificate or other certificate employed. PCUs certified under UL 1610 must meet FIPS 197 or FIPS 140-2 encryption certification and methods. For PCUs certified under UL1076, only FIPS 140-2 is the acceptable encryption certification and method. Alternative methods shall be approved by the AO and noted on the IDS Certificate

(11) The SCI cleared IDS Administrator(s) shall change maintenance and master profiles, PINs or passcodes from their default settings to a unique PIN or passcode.

c) Integrated IDS and Remote Terminal Access.

(1) US government LAN or WAN requires the AO's Chief Information Officer (CIO) to be consulted before connecting an IDS. The system hosting the IDS shall be issued Authority to Operate (ATO) by the agency CIO, following the FISMA Risk Management Framework as outlined in NIST SP 800-53.

(2) For IDS that have been integrated into a networked system (local area network (LAN) or wide area network (WAN)), the requirements below shall be met.

(a) IDS System software shall be installed on a host computing device that is logically and physically restricted to corporate/government security elements cleared to the SCI level. The host device shall be located in a Physically Protected Space, which is defined as a locked room with walls, floor and ceiling that are fixed in place forming a solid physical boundary to which only SCI-cleared personnel have access. If uncleared personnel or personnel with less than SCI indoctrination require access to this space, they shall be escorted by authorized SCI-cleared personnel. The door(s) shall use Commercial Grade 1 hardware fitted with high security key cylinder(s) in compliance with UL 437. This room will be protected by a UL Extent 3 burglar alarm system and access control unless manned 24 hours.

(b) All system components and equipment shall be isolated in a manner that may include, but are not limited to firewalls, Virtual Private Networks, Virtual Routing Tables, Application Level security mechanisms or similar enhancements, that are configured to allow secure and private data transfers only between the PCU, host computer, remote terminal and monitoring station.

(c) If any component of the IDS is remotely programmable, continuous network monitoring is required. Continuous network monitoring includes auditing and reporting of network intrusion detection and prevention systems used in A.3.c.2.b.

(d) A secondary communication path may be utilized to augment an existing data communication link to reduce investigations of data communication failures of less than five minute duration. The supervision provided by the secondary communication path shall be equivalent to that of the primary communication path. The secondary communications path may only be wireless if approved by the AO in consultation with the CTTA and/or the appropriate technical authority.

(e) A unique user ID and password is required for each individual granted access to the system host computing devices or remote terminal. Passwords shall be a minimum of twelve characters consisting of alpha, numeric, and special characters, and shall be changed every six months or utilize US Government Personal Identity Verification (PIV) Card or Common Access Card (CAC) with two factor certificate authentication.

(f) Individuals with IDS administrative access shall immediately notify the AO or designee of any unauthorized modifications.

(g) All transmissions of system information over the LAN/WAN shall be encrypted using National Institute of Standards and Technology (NIST) FIPS 140-2, VPN, or closed and sealed conveyance (see A.2.e). FIPS-197 (AES) may be used with AO approval.

(h) Remote System terminals shall:

- Utilize role based user permissions (e.g. Super User, SO, Guard) as approved by the AO. USG installations shall be in compliance with paragraph 7.A.3.c.1Prohibit Non SCI Cleared personnel from modifying the IDS or ACS.

- Require an independent user ID and password in addition to the host login requirements. Requirements for IDS Systems Software Passwords shall be: a unique user ID and password for each individual granted access to the remote terminal. Passwords shall be a minimum of twelve characters consisting of alpha, numeric, and special characters and shall be changed every six months or utilize US Government Personal Identity Verification (PIV) Card or Common Access Card (CAC) with two factor certificate authentication if supported by the application.

- Host systems shall log and monitor failed login attempts. All remote sessions shall be documented and accessible to AO upon request.
- All Host systems and PCUs shall be patched and maintained to implement current firmware and security updates. USG systems shall be in compliance with Information Assurance Vulnerability Alert (IAVA) guidance.

B. IDS Modes of Operation

1. General Information

   a) The system shall operate in either armed or disarmed mode.

   b) There shall be no remote capability for changing the mode of operation by non-SCI cleared personnel.

   c) Changing arm/disarm status of the system shall be limited to SCI-indoctrinated personnel.

2. Requirements for Disarmed Mode

   a) When in disarmed mode, normal authorized entry into the SCIF, in accordance with prescribed security procedures, shall not cause an alarm.

   b) A record shall be maintained that identifies the person responsible for disarming the system.

   c) Tamper circuits and emergency exit door circuits shall remain in the armed mode of operation.

   d) The PCU shall have the ability to allow alarm points to remain in armed status while other points are in disarmed status.

3. Requirements for Armed Mode

   a) The system shall be placed into armed mode when the last person departs the SCIF.

   b) A record shall be maintained identifying the person responsible for arming the system.

   c) Each failure to arm or disarm the system shall be reported to the responsible SCIF Security Manager. Records of these events shall be maintained for two years.

   d) When in the armed mode, any unauthorized entry into the SCIF shall cause an alarm to be immediately transmitted to the monitoring station.

4. Requirements for Maintenance and Zone Shunting/Masking Modes

   a) When maintenance is performed on a system, the monitoring station must be notified and logged. The initiation of system maintenance can only be performed by an SCI cleared IDS administrator or SCIF Security Officer (SO).

b) When an IDE point is shunted or masked for reasons other than maintenance, it shall be displayed as such at the monitoring station throughout the period the condition exists.

c) Any sensor that has been shunted shall be reactivated upon the next change in status from armed to disarmed.

d) All maintenance periods shall be archived in the system.

e) A Personal Identification Number (PIN) is required, for maintenance purposes, to be established and controlled by the SCI cleared IDS administrator or SCIF SO. Procedures shall be documented in the SCIF SOP.

f) Portable Electronic Devices (PEDs) are allowed attachment to system equipment either temporarily or permanently for the purposes of system maintenance, repair and reporting (See A.3.c). In addition, when utilizing a stand-alone device, the requirements below shall be met.

(1) Such devices shall be kept under control of SCI-cleared personnel.

(2) When not in use, the PED shall be maintained in a Physically Protected Space (see A.3.c.2.a).

(3) Mass storage devices containing SCIF alarm equipment details, configurations, or event data will be protected at an appropriate level approved by the AO.

g) After the initial installation, the capability for remote diagnostics, maintenance, or programming of IDE shall be accomplished only by SCI-cleared personnel and shall be logged or recorded.

5. Requirements for Electrical Power

a) In the event of primary power failure, the system shall automatically transfer to an emergency electrical power source without causing alarm activation.

b) Twenty-four hours of uninterruptible backup power is required and shall be provided by batteries, an uninterruptible power supply (UPS), generators, or any combination.

c) An audible or visual indicator at the PCU shall provide an indication of the primary or backup electrical power source in use.

d) Equipment at the monitoring station shall visibly and audibly indicate a failure in a power source or a change in power source. The individual system that failed or changed shall be indicated at the PCU or monitoring station as directed by the AO.

6. Monitoring Stations

a) Monitoring stations shall be government-managed or one of the following in accordance with UL 2050:

(1) AO-operated monitoring station.

(2) Government contractor monitoring station (formerly called a proprietary central station).

(3) National industrial monitoring station.

(4) Cleared commercial central station (see NISPOM, Chap. 5).

b) Monitoring station employees shall be eligible to hold a U.S. SECRET clearance.

c) Monitoring station operators shall be trained in system theory and operation to effectively interpret system incidents and take appropriate response action.

d) Records shall be maintained shall be maintained in accordance with Chapter 12 section L.

C. Operations and Maintenance of IDS

1. Alarm Response

a) Alarm activations shall be considered an unauthorized entry until resolved.

b) The response force shall take appropriate steps to safeguard the SCIF, as permitted by a written support agreement, until an SCI-indoctrinated individual arrives to take control of the situation.

c) An SCI indoctrinated individual must arrive in accordance with UL 2050 requirements (60 minutes) or the response time approved by the AO, after receipt of the alarm signal to conduct an internal inspection of the SCIF, attempt to determine the probable cause of the alarm activation, and reset the IDS prior to the departure of the response force.

2. System Maintenance

a) Maintenance and repair personnel shall be escorted if they are not TOP SECRET-cleared and indoctrinated for SCIF access.

b) Repairs shall be initiated by a service technician within 4 hours of the receipt of a trouble signal or a request for service.

c) The SCIF shall be continuously manned by SCI-indoctrinated personnel on a 24-hour basis until repairs are completed or alternate documented procedures approved by the AO are initiated.

d) The following apply to emergency-power battery maintenance:

(1) The battery manufacturer's periodic maintenance schedule and procedures shall be followed and documented in the system's maintenance logs and retained for two years. Batteries should be replaced per manufacture's recommendations or as environmental conditions dictate.

(2) If the communications path is via a network, the local uninterruptible power source for the network shall also be tested.

(3) If a generator is used to provide emergency power, the manufacturers recommended maintenance and testing procedures shall be followed.

e) Network Maintenance

(1) System administrators shall maintain configuration control, ensure the latest operating system security patches have been applied, and configure the operating system to provide a high level of security.

(2) Inside the U.S., network maintenance personnel within a SCIF shall be a U.S. person and be escorted by cleared SCIF individuals.

(3) Outside the U.S., network maintenance personnel shall be U.S. TOP SECRET-cleared or U.S. SECRET-cleared and escorted by SCIF personnel.

D. Installation and Testing of IDS

1. Personnel Requirements

a) Installation and testing within the U.S. shall be performed by U.S. companies using U.S. citizens.

b) Installation and testing outside of the U.S. shall be performed by personnel who are U.S. TOP SECRET-cleared or U.S. SECRET-cleared and escorted by SCIF personnel.

2. Installation Requirements

All system components and elements shall be installed in accordance with requirements of this document, UL 2050, and manufacturer's instructions and standards.

3. Testing

a) Acceptance testing shall be conducted on systems prior to operational use to provide assurance that they meet all requirements of this section prior to SCIF accreditation.

b) Semi-annual IDS testing shall be conducted to ensure continued performance.

c) Records of testing and test performance shall be maintained in accordance with documentation requirements.

d) Motion Detection Sensor Testing

(1) All motion detection sensors shall be tested to ensure activation of the sensor at a minimum of four consecutive steps at a rate of one step per second; that is, 30 inches ± 3 inches or 760 mm ± 80 mm per second. The four-step movement shall constitute a "trial."

(2) The test shall be conducted by taking a four-step trial, stopping for three to five seconds, and taking another four-step trial.

(3) Trials shall be repeated throughout the SCIF and from different directions.

(4) An alarm shall activate at least three out of every four consecutive trials made by moving progressively through the SCIF.

e) HSS Testing

All HSS devices shall be tested to ensure that an alarm signal activates before the non-hinged side of the door opens beyond the thickness of the door from the closed position, e.g., the sensor initiates before the door opens 1¾ inch for a 1¾ inch door.

f) Tamper Testing

(1) Each IDS equipment cover shall be individually removed or opened to ensure there is alarm activation at the PCU or monitoring station in both the secure and access modes.

(2) Tamper detection devices need only be tested when installed.

(3) The AO may require more frequent testing of tamper circuits.

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Chapter 8. Access Control Systems (ACS)

A. SCIF Access Control

1. Guidelines

a) SCIFs shall be controlled by SCI-indoctrinated personnel or by an AO- approved ACS to ensure access is restricted to authorized personnel.

b) Personnel access control shall be utilized at all SCIFs.

c) Visual recognition of persons entering the SCIF by an SCI-indoctrinated person at the entrance to a SCIF is the ideal access control.

d) Entrances where visitor control is conducted shall be under continuous visual observation unless the SCIF is properly secured.

e) When the SCIF is an entire building, access control shall occur at the building perimeter.

2. ACS Requirements if Continuous Visual Observation is Not Possible

a) An automated personnel ACS that verifies an individual's identity before the individual is permitted unescorted access shall be utilized when personal recognition and verification is not used. Automated verification shall employ **two** of the following three technologies:

(1) Identification (ID) badge or card used in conjunction with the access control device that validates the identity of the person to whom the card is issued. Compromised or lost access cards shall be reported immediately and updated in the system to reflect "no access."

(2) A personal identification number (PIN) that is entered into the keypad by each individual. The PIN shall consist of four or more random digits, with no known or logical association to the individual or which can be derived from the person or system generated. Compromised PINs shall be reported immediately to the facility Security Officer (SO) or SCIF SO and updated in the system to reflect "no access."

(3) Biometric personal identity verification using unique personal characteristics such as fingerprint, iris scan, palm print, etc.

b) The automated personnel ACS shall ensure that the probability of an unauthorized individual gaining access is no more than one in ten thousand while the probability of an authorized individual being rejected access is no more than one in one thousand. Manufacturers must certify in writing that their system meets these criteria.

B. ACS Administration

1. ACS administrators shall be SCI-indoctrinated.

2. Remote release buttons that by-pass the ACS shall be inside the SCIF and in a location that provides continuous visual observation of personnel entering the SCIF.

3. ACSs shall not be used to secure an unoccupied SCIF.

4. When not occupied, SCIFs shall be alarmed and in secure mode in accordance with Chapter 7 and secured with an approved GSA FF-L-2740A combination lock.

5. Authorized personnel who permit another individual to enter the SCIF shall verify the individual's authorized access.

6. SCIF access authorization shall be removed when the individual is transferred, terminated, or the access approval is suspended or revoked.

C. ACS Physical Protection

1. Card readers, keypads, communication interface devices, and other access control equipment located outside the SCIF shall be tamper-protected and be securely fastened to a wall or other fixed structure.

2. Electrical components, associated wiring, or mechanical links shall be accessible only from inside the SCIF.

3. System data that is carried on transmission lines (e.g., access authorizations, personal identification, or verification data) to and from equipment located outside the SCIF shall be protected using FIPS AES certified encrypted lines. If this communication technology is not feasible, transmission lines shall be installed as approved by the AO.

4. Equipment containing access-control software programs shall be located in the SCIF or a SECRET controlled area.

5. Electric door strikes installed in conjunction with a personnel ACS shall have a positive engagement and be approved under UL 1034 for burglar resistance.

D. ACS Recordkeeping

1. Records shall reflect the active assignment of ID badge/card, PIN, level of access, entries, and similar system-related information.

2. Records and information concerning encoded ID data, PINs, Authentication data, operating system software, or any other data associated with the personnel ACS shall be secured in an open-storage facility or, when unattended, secured in a GSA-approved container in a closed-storage facility. Access to such data shall be restricted to only SCI-indoctrinated personnel responsible for the access control system.

3. Records of personnel removed from the system shall be retained for two years from the date of removal.

4. Records of security incidents (violations/infractions) regarding ACS shall be retained by the SO for five years from the date of an incident or until investigations of system violations and incidents have been resolved.

E. Using Closed Circuit Television (CCTV) to Supplement ACS

1. CCTV may be used to supplement the monitoring of a SCIF entrance for remote control of the door from within the SCIF. The system shall present no technical security hazard.

2. The remote control device shall be within the interior of the SCIF.

3. The system shall provide a clear view of the SCIF entrance and shall be monitored/operated by SCI-indoctrinated personnel within the SCIF.

4. CCTV communication lines should be located within the SCIF. Communication lines that must run external to the SCIF shall be installed to prevent tampering as approved by the AO.

F. Non-Automated Access Control

1. Non-automated access control devices (mechanical, electric, or electromechanical) may be approved by the AO to control access to SCIFs where the number of personnel that require access is low and there is only one entrance.

2. Combinations shall consist of four (4) or more random digits.

3. The use of pass keys to bypass such devices should be avoided except when local fire/safety codes require them. Any pass keys for such devices must be strictly controlled by SCI-indoctrinated personnel.

4. Mechanical access control devices (e.g., UNICAN, Simplex) shall be installed to prevent manipulation or access to coding mechanisms from outside the door.

5. The following shall apply to electric or electromechanical access control devices:

   a) The control panel or keypad shall be installed in such a manner to preclude unauthorized observation of the combination or the actions of a combination change.

   b) The selection and setting of combinations shall be accomplished by the SO and shall be changed when compromised or deemed necessary by the SO.

   c) The control panel in which the combination and all associated cabling and wiring is set shall be located inside the SCIF and shall have sufficient physical security to deny unauthorized access to its mechanism.

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Chapter 9. Acoustic Protection

A. Overview

1. This establishes DNI guidelines to protect classified conversations from being inadvertently overheard outside a SCIF.

2. This is not intended to protect against deliberate technical interception of audio emanations.

B. Sound Group Ratings

The ability of a SCIF structure to retain sound within the perimeter is rated using a descriptive value, the Sound Transmission Class (STC). To satisfy the normal security standards of SCIFs, the following transmission attenuation groups have been established:

- Sound Group 3 - STC 45 or better. Loud speech from within the SCIF can be faintly heard but not understood outside of the SCIF. Normal speech is unintelligible with the unaided human ear.
- Sound Group 4 - STC 50 or better. Very loud sounds within the SCIF, such as loud singing, brass music, or a radio at full volume, can be heard with the human ear faintly or not at all outside of the SCIF.

C. Acoustic Testing

1. Audio tests shall be conducted to verify standards are met. Tests may be instrumental or non-instrumental as approved by the AO. Test method used shall be detailed in the CSP.

2. Instrumental Acoustic Tests

a) Only those with training on audio testing techniques shall conduct instrumental acoustic tests

b) With all SCIF doors closed, all perimeter walls and openings (e.g., air returns, doors, windows, etc.) shall be tested along multiple points to ensure that either Sound Group 3 or 4 is met.

c) Audio test sources shall have a variable sound level output.

d) The output frequency range shall include normal speech.

e) Test speakers shall be placed six feet from the test wall and 4 feet off the floor.

f) Audio gain of the test source shall produce “loud or very loud speech” as defined by Sound Group 3 and 4 levels respectively.

g) As an alternative, instrumented testing may be performed to Noise Isolation Class (NIC) standards. Results shall comply with NIC 40 for Sound Group 3 and NIC 45 for Sound Group 4.

3. Non-Instrumental Acoustic Tests

All non-instrumental tests shall be approved by the AO.

D. Construction Guidance for Acoustic Protection

1. The SCIF perimeter shall be designed and constructed to meet Sound Group 3 or better standards. (See construction drawings for Wall A, B, or C.)

2. Areas that provide for amplified conversations, such as conference centers, video teleconference (VTC) rooms, or similar areas, shall be designed and constructed to meet Sound Group 4 standards. (See construction drawings for Wall A, B, or C.)

3. Utility (e.g., power, signal, telephone) distribution shall be surface mounted to a sound-treated wall and shall not completely penetrate the sound-engineered structure.

E. Sound Transmission Mitigations

1. Construction of walls as described in Chapter 3 (Wall types A, B and C) or with brick, concrete, or other substantive material and acoustically treating penetrations, walls and doors should provide the necessary acoustic protection for Sound group 3.

2. When Sound Group 3 or 4 cannot be met with normal construction, supplemental mitigations to protect classified discussions from being overheard by unauthorized persons may include but not be limited to the following:

a) Structural enhancements such as the use of high-density building materials (i.e., sound deadening materials) can be used to increase the resistance of the perimeter to vibration at audio frequencies.

b) Facility design can include a perimeter location or stand-off distance which prevents non-SCI-indoctrinated person(s) traversing beyond the point where SCI discussions become susceptible to interception. For example, use of a perimeter fence or protective zone between the SCIF perimeter walls and the closest "listening place" is permitted as an alternative to other sound protection measures.

c) Sound masking devices, in conjunction with an amplifier and speakers or transducers, can be used to generate and distribute vibrations or noise; noise sources may be noise generators, tapes, discs, or digital audio players.

d) Speakers/transducers must produce sound at a higher level than the voice conversations within the SCIF.

e) Speakers/transducers shall be placed close to, or mounted on, any paths that would allow audio to leave the area, including doors, windows, common perimeter walls, vents/ducts, and any other means by which voice can leave the SCIF.

f) Wires and transducers shall, to the greatest extent possible, be located within the perimeter of the SCIF.

g) The sound masking system shall be subject to inspection during TSCM evaluations.

h) If the AO determines risk to be low, a speaker may be installed outside the SCIF door if the following conditions are met:

- The cable exiting the SCIF shall be encased within rigid conduit.
- The sound masking system shall be subject to review during TSCM evaluations.

i) For common walls, the speakers/transducers shall be placed so the sound optimizes the acoustical protection.

j) For doors and windows, the speakers/transducers shall be placed close to the aperture of the window or door and the sound projected in a direction facing away from conversations.

k) Once the speakers or transducers are optimally placed, the system volume shall be set and fixed. The volume level for each speaker shall be determined by listening to conversations outside the SCIF or area to be protected, and the speaker volume adjusted until conversations are unintelligible from outside the SCIF.

l) Sound-source generators shall be permanently installed and not contain an AM/FM receiver and shall be located within the SCIF.

m) Any sound-source generator within the SCIF that is equipped with a capability to record ambient sound shall have that capability disabled.

n) Examples of government-owned or government-sponsored sound-source generators are given below:

- Audio amplifier with a standalone computer (no network connection).
- Audio amplifier with a cassette tape player, compact disc (CD) player, or digital audio player, or with a digital audio tape (DAT) playback unit.
- Integrated amplifier and playback unit incorporating any of the above music sources.
- A noise generator or shift noise source generator using either white or pink noise.

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Chapter 10. Portable Electronic Devices with Recording Capabilities and Embedded Technologies (PEDs/RCET)

A. Approved Use of PEDs/RCET in a SCIF

1. DNI Executive Correspondence, ES 2017-00043, Wireless Technology in the Intelligence Community, should be referred to in all cases dealing with Portable Electronic Devices with Wireless capabilities.

2. Heads of IC elements will institute and maintain mitigation programs (countermeasures) if they allow introduction of PEDs/RCETs with recording capabilities into SCIFs under their cognizance. Such decisions are not reciprocal or applicable to facilities under the cognizance of other heads of IC elements.

3. Medical devices. Approval for medical devices will comply with all applicable laws and oversight policies, including the Rehabilitation Act, and the latest IC medical device approval process. As a minimum, the medical device must be reviewed to determine any technical security issues introduced by the device. Based on the security/technical review, medical devices may be approved by the AO for introduction and use within a SCIF.

4. Recording capabilities and restricted technologies are technologies that introduce vulnerabilities to information and therefore impact SCIF security. These technologies include, but are not limited to, radio frequency transmitters, audio and video recorders, cameras, microphones, data storage devices, computing devices, memory sticks, thumb drives or flash memory and devices with USB connectivity.

5. Any approval for radio frequency transmitters shall require the AO and the Certified TEMPEST Technical Authority (CTTA) collaborate and approve (as required) the introduction and use of PEDs/RCETs into a SCIF where there is a valid mission related requirement.

6. The AO, and when appropriate, the information systems (ISs) authorizing official(s), shall collaborate and approve (as required) the introduction and use of PEDs/RCETs into a SCIF when there is a valid mission related requirement.

7. Outside the U.S., heads of intelligence elements may approve PED/RCET usage by waiver and include the following:

- Defined mission need for PED/RCET usage.
- Defined period of time.
- Statement of residual risk

8. Within the U.S., if the AO determines the risk from PEDs/RCET to SCI under their cognizance is acceptable, taking a PED/RCET into the SCIF may be allowed with the following restrictions:

a) A comprehensive risk assessment addressing each vulnerability, security concern and the component of risk must be completed.

b) Only PEDs/RCET with low risk may be allowed entry to a SCIF.

c) Mitigation shall be applied to PEDs/RCET evaluated to be high and medium risk to reduce the PED/RCET risk to low before the device may be allowed entry.

d) Assessments may result in an AO determination to prohibit specific PEDs/RCET.

B. Prohibitions

1. Personally-owned PEDs/RCETs are prohibited from processing SCI. Connecting personally-owned PEDs/RCETs to an unclassified IS inside SCIFs may only be done when wireless capability is physically disconnected and has the approval of the AO for the IS.

2. Personally-owned PEDs/RCETs are prohibited in SCIFs outside the U.S. If the AO determines that mission requirements dictate a need, government- or contractor-owned PEDs/RCETs may be permitted in a SCIF by specific exception or if the AO determines the risk is low.

3. If a PED/RCET is transported outside the U.S. and left unattended or physical control is lost, that device shall not be reintroduced into a SCIF.

C. PED/RCET Risk Levels

1. General Information

a) Levels of risk are based on the functionality of PEDs/RCET.

b) The AO and appropriate authorizing official for the IS (when a portable IS is involved) will determine risk level and mitigation requirements for devices not addressed.

2. Low-, Medium-, and High-risk PEDs/RCET.

a) Low-risk PEDs/RCET are devices without recording or transmission capabilities and may be allowed into a SCIF by AO without mitigation. Low-risk PEDs/RCET include, but are not limited to, the following:

- Electronic calculators, spell checkers, language translators, etc.
- Receive-only pagers.
- Audio and video playback devices with no storage capability.
- Radios (receive-only).
- Infrared (IR) devices that convey no intelligence data (e.g., text, audio, video, etc.), such as an IR mouse or remote control.

b) Medium-risk PEDs/RCET are devices with built-in features that enable recording or transmitting digital text, digital images/video, or audio data; however, these features can be physically disabled. Medium-risk PEDs/RCET may be allowed in a

SCIF by the AO with appropriate mitigations. Examples of medium-risk PEDs/RCET include, but are not limited to, the following:

- Voice-only cellular telephones.
- Portable ISs, such as personal digital assistants (PDAs), tablet personal computers, etc.
- Devices that may contain or be connected to communications modems
- Devices that have microphones or recording capabilities

c) High-risk PEDs/RCET are those devices with recording and/or transmitting capabilities that require more extensive or technically complex mitigation measures to reduce the inherent risk or those that cannot be sufficiently mitigated with current technology. The AO may approve entry and use of government- and contractor-owned PEDs/RCET for official business provided mitigation measures are in place that reduces the risk to low. Examples include, but are not limited to, the following:

- Electronic devices with RF transmitting (IEEE 802.11, Bluetooth, etc.).
- Photographic, video, and audio recording devices.
- Multi-function cellular telephones.

D. Risk Mitigation

1. Heads of IC elements shall establish risk mitigation programs if high- or medium-risk PEDs/RCET are allowed into SCIFs.

2. Risk mitigation programs shall contain the following elements:

a) Formal approval process for PEDs/RCET.

b) Initial and annual refresher training for those individuals with approval to bring PEDs/RCET into a SCIF.

c) Device mitigation compliance documents listing the specific PEDs/RCET, their permitted use, required mitigations, and residual risk after mitigation.

d) A user agreement that specifies the following:

(1) The USG or a designated representative may seize the PED/RCET for physical and forensic examination at the government's discretion.

(2) The USG and the designated representative are not responsible for any damage or loss to a device or information stored on personally-owned PEDs/RCET resulting from physical or forensic examination.

3. Risk mitigation programs may include the following elements:

a) Registration of PED/RCET serial numbers.

b) PED/RCET security training program.

c) Reporting procedures for loss or suspected tampering.

d) Labeling approved PEDs/RCET for easy identification.

e) Electronic detection equipment to detect transmitters/cell phones.

Chapter 11. Telecommunications Systems

A. Applicability

1. This guidance is compatible with, but may not satisfy, security requirements of other disciplines such as Information Systems Security, Communications Security (COMSEC), Operational Security (OPSEC), or TEMPEST.

2. This section outlines the security requirements that shall be met to ensure the following:

- Protection of information.
- Configuration of unclassified telecommunications systems, devices, features, and software.
- Access control.
- Control of the cable infrastructure.

B. Unclassified Telephone Systems

1. A baseline configuration of all unclassified telephone systems, devices, features, and software shall be established, documented, and included in the SCIF FFC.

2. The AO shall review the telephone system baseline configuration and supporting information to determine if the risk of information loss or exploitation has been suitably mitigated.

3. When security requirements cannot be met, unclassified telephone equipment shall be installed and maintained in non-discussion areas only.

4. When not in use, unclassified telephone systems shall not transmit audio and shall be configured to prevent external control or activation, technical exploitation, or penetration.

5. Unclassified telephone systems shall incorporate physical and software access controls to prevent disclosure or manipulation of system programming and data. The following specific requirements shall be met:

a) On-hook and off-hook audio protection shall be provided by equipment identified by the National Telephone Security Working Group within TSG-6/CNSSI 5006, National Instruction for Approved Telephone Equipment, or an equivalent TSG 2/ CNSSI 5002:

(1) The purpose of a TSG-2 or CNSS 5002 Computerized Telephone Switch (CTS) installation is to prevent manipulation of telephone instruments to obtain audio from within the SCIF while the instrument is in an "on-hook" condition.

(2) When isolation is provided by a CTS installed IAW TSG-2 or CNSS 5002, the AO accepts the risk on-hook audio from the SCIF may be present on all instrument wiring until it reaches the CTS due to instrument configuration, design, or breakdown. *(TSG-2/CNSS 5002 does not address procedures to determine security of the station itself.)*

(3) To provide the necessary level of security, the Physically Protected Space (PPS) where the CTS is installed must meet equivalent security and access control standards as the SCIF it supports to provide positive physical protection for the CTS and all of its parts. *(CNSSI 5002 para 7.A.(1))*. This includes all instruments, cables, lines, intermediate wiring frames, and distributed CTS modules necessary for the functioning of the instruments.

(4) The AO may require all instrument wiring exiting between the SCIF and PPS which is not at the SCIF level be contained in a closed and sealed metal conveyance as defined in Chapter 7.A.2 to ensure physical security of the instrument wiring.

(5) Telephones or instruments not type-accepted will be presumed to have on-hook audio available at the mounting cord until determined otherwise. Determining telephone stations do not have on-hook audio hazards requires a technical investigation and specific equipment. These investigations and determinations may only be conducted by a TSCM team or National Telephone Security Working Group (NTSWG) authorized telephone laboratory.

b) If a Computerized Telephone System (CTS) is selected for isolation, it shall be installed and configured as detailed in TSG 2 with software and hardware configuration control and audit reporting (such as station message detail reporting, call detail reporting, etc.).

c) System programming shall not include the ability to place, or keep, a handset off-hook.

d) Configuration of the system shall ensure that all on-hook and off-hook vulnerabilities are mitigated.

e) When local or remote CTS administration terminals are not contained within a controlled area and safeguarded against unauthorized manipulation, the use of CNSSI 5006 approved telephone instruments shall be required, regardless of the CTS configuration.

f) Speakerphones and audio conferencing systems shall not be used on unclassified telephone systems in SCIFs. Exceptions to this requirement may be approved by the AO when these systems have sufficient audio isolation from other classified discussion areas in the SCIF and procedures are established to prevent inadvertent transmission outside the SCIF.

g) Features used for voice mail or unified messaging services shall be configured to prevent access to remote diagnostic ports, internal dial tone, and dial plans.

h) Telephone answering devices and facsimile machines shall not contain features that introduce security vulnerabilities, e.g., remote room monitoring, remote programming, or other similar features that may permit off-premise access to room audio.

i) All unclassified telephone systems and associated infrastructure shall be physically isolated from classified information and telecommunications systems in accordance with DNI and CNSS TEMPEST guidance.

j) TSG6/CNSSI 5006 approved instruments or compliance with CNSSI 5000 is required for installation in SCIFs for Voice over Internet Protocol (VoIP) systems installed in a SCIF. TSG6/CNSSI 5006 approved instruments must be installed following the manufacturer's requirements. For non-TSG6/CNSSI 5006 approved instruments, the security requirements and installation guidelines contained in the National Telecommunications Security Working Group (NTSWG) publication CNSSI 5000 shall be followed for Voice over Internet Protocol (VoIP) systems installed in a SCIF.

C. Unclassified Information Systems

1. Unclassified information systems shall be safeguarded to prevent hardware or software manipulation that could result in the compromise of data.

2. Information systems equipment with telephonic or audio features shall be protected against remote activation and/or removal of audio (analog or digitized) information.

3. Video cameras used for unclassified video teleconferencing and video recording equipment shall be deactivated and disconnected when not in use.

4. Video devices shall feature a clearly visible indicator to alert SCIF personnel when recording or transmitting.

D. Using Closed Circuit Television (CCTV) to Monitor the SCIF Entry Point(s)

1. CCTV may be used to supplement the monitoring of a SCIF entrance and to record events for investigation.

2. The system shall present no technical security hazard to the SCIF.

3. The system and all components, including communications and control lines, shall be exterior to the SCIF perimeter.

4. The system may provide a clear view of the SCIF entrance but not enable the viewer to observe classified information when the door is open nor external control pads or access control components that would enable them to identify PINs.

E. Unclassified Wireless Network Technology

1. The use of devices or systems utilizing wireless technologies pose a high risk and require approval from the AO, CTTA, and IT systems approving authority prior to introduction into the SCIF.

2. Wireless systems shall meet all TEMPEST and TSCM requirements and shall be weighed against the facilities overall security posture (i.e., facility location, threat, as well as any compensatory countermeasures that create SID) when evaluating these systems.

3. All separation and isolation standards provided in TEMPEST standards are applicable to unclassified wireless systems installed or used in SCIFs.

F. Environmental Infrastructure Systems

1. The FFC shall include information on whether or not environmental infrastructure systems (also referred to as building maintenance systems) are located in the SCIF. Examples include the following:

- Premise management systems
- Environmental control systems
- Lighting and power control units
- Uninterrupted power sources

2. The FFC shall identify all external connections for infrastructure systems that service the SCIF. Examples of the purpose of external connections include the following:

- Remote monitoring
- Access and external control of features and services
- Protection measures taken to prevent malicious activity, intrusion, and exploitation.

G. Emergency Notification Systems

1. The introduction of electronic systems that have components outside the SCIF perimeter is prohibited, with the following exceptions:

a) The system is approved by the AO.

b) The system is required for security purposes.

c) The system is required under life safety regulations.

2. If required, and speakers or other transducers are part of a system that is not wholly contained in the SCIF but are installed in the SCIF for life safety or fire regulations, the system must be protected as follows:

a) All incoming wiring shall breach the SCIF perimeter at one point. TEMPEST or TSCM concerns may require electronic isolation and shall require review and approval by the CTTA.

b) One-way (audio into the SCIF) communication systems shall have a high gain amplifier.

c) Two-way communication systems shall only be approved when absolutely necessary to meet safety/security requirements. They shall be protected so that audio cannot leave the SCIF without the SCIF occupants being alerted when the system is activated.

d) All electronic isolation components shall be installed within the SCIF and as close to the point of SCIF penetration as possible.

H. Systems Access

1. Installation and maintenance of unclassified systems and devices supporting SCIF operations may require physical or remote access. The requirements outlined in this section shall apply to telecommunications devices located within the SCIF or in a controlled area outside the SCIF.

2. Installation and maintenance personnel requiring physical access shall possess the appropriate clearance and access, or will be escorted and monitored at all times within the SCIF by technically knowledgeable, U.S. SCI-indoctrinated personnel.

3. Remote maintenance shall be protected against manipulation or activation.

4. All capabilities for remote maintenance and diagnostic services shall be specified in the FFC.

5. The FFC shall identify all procedures and countermeasures to prevent unauthorized system access, unauthorized system modification, or introduction of unauthorized software.

6. Remote maintenance and diagnosis may be performed from a SCIF or an adjacent controlled area over a protected link in accordance with FIPS AES standards.

7. Telephone systems only may be accessed over an unclassified telephone line as specified in TSG 2 Standard, Section 4.c.

I. Unclassified Cable Control

1. To the extent possible, all telecommunications cabling shall enter the SCIF through a single opening and allow for visual inspection.

2. Cable, either fiber or metallic, shall be accounted for from the point of entry into the SCIF.

    a) The accountability shall identify the precise use of every cable through labeling.

    b) Log entries may also be used.

    c) Designated spare conductors shall be identified, labeled, and bundled together.

3. Unused conductors shall be removed. If removal is not feasible, the metallic conductors shall be stripped, bound together, and grounded at the point of ingress/egress.

4. Unused fiber shall be uncoupled from the interface within the SCIF, capped, and labeled as unused fiber.

J. Protected Distribution Systems

1. Unencrypted communication cables transmitting SCI between accredited SCIFs shall be installed in a Protective Distribution System that complies with standards established in CNSSI 7003, Protected Distribution System.

2. PDS used to protect SCI shall be approved by the CSA AO.

K. References

1. Overview

   a) The NTSWG publishes guidance for the protection of sensitive information and unclassified telecommunications information processing systems and equipment.

   b) NTSWG documents are currently in transition from TSG/NTSWG documents to Committee on National Security Systems (CNSS) publications.

   c) The List of References is provided for use by personnel concerned with telecommunications security.

2. List of References

   a) TSG Standard 1 (Introduction to Telephone Security). Provides telephone security background and approved options for telephone installations in USG sensitive discussion areas.

   b) TSG Standard 2 (TSG Guidelines for Computerized Telephone Systems) and Annexes. Establishes requirements for planning, installing, maintaining, and managing CTS, and provides guidance for personnel involved in writing contracts, inspecting, and providing system administration of CTS.

   c) TSG Standards 3, 4, 5, and CNSSI 5001. Contains design specifications for telecommunication manufacturers and are not necessarily applicable to facility security personnel.

   d) CNSSI 5000. Establishes requirements for planning, installing, maintaining, and managing VoIP systems.

   e) CNSSI 5006. Lists approved equipment which inherently provide on-hook security.

   f) NTSWG Information Series (Computerized Telephone Systems). A Review of Deficiencies, Threats, and Risks, December 1994). Describes deficiencies, threats, and risks associated with using computerized telephone systems.

   g) NTSWG Information Series (Executive Overview, October 1996). Provides the salient points of the TSG standards and presents them in a non-technical format.

   h) NTSWG Information Series (Central Office (CO) Interfaces, November 1997). Provides an understanding of the types of services delivered by the local central office and describes how they are connected to administrative telecommunications systems and devices.

i) NTSWG/NRO Information Series (Everything You Always Wanted to Know about Telephone Security…but were afraid to ask, 2nd Edition, December 1998). Distills the essence of the TSG standards (which contain sound telecommunications practices) and presents them in a readable, non-technical manner.

j) NTSWG/NRO Information Series (Infrastructure Surety Program…securing the last mile, April 1999). Provides an understanding of office automation and infrastructure system protection that contributes to SCIF operation.

k) NTSWG Information Series (Computerized Telephone Systems Security Plan Manual, May 1999). Assists to implement and maintain the "secure" operation of CTSs as used to support SCIF operations. (The term "secure" relates to the safe and risk-free operation, not the use of encryption or a transmission security device.)

l) Director of National Intelligence, Intelligence Community Directive 702, Technical Surveillance Countermeasures.

m) Director of National Intelligence, Intelligence Community Directive 503, Intelligence Community Information Technology Systems Security Risk Management, Certification and Accreditation.

n) SPB Issuance 00-2 (18 January 2000). Infrastructure Surety Program and the Management Assessment Tool.

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Chapter 12. Management and Operations

A. Purpose

To establish safeguards and procedures necessary to prevent the unauthorized disclosure of SCI and other classified national security information in SCIFs. To define administrative processes that shall provide a secure operating environment and enable adequate security oversight, management, and operations of SCIFs.

B. SCIF Repository

1. As required by ICD 705, the DNI shall manage an inventory of information on all SCIFs which shall be reported to the DNI via the SCIF repository not later than 180 days after the effective date of ICD 705 and updated no later than 30 days after changes occur thereafter.

2. Reportable SCIF Administrative Information:

- SCIF ID
- AO ID
- Location of SCIF
  - In U.S.
  - Outside U.S.
  - Under COM
- SCIF Type
  - Closed Storage
  - Open Storage
  - SWA
  - TSWA
  - T-SCIF
- SID
- Initial Accredited Date
- Re-Accreditation Date
- Review date
- Waivers
- Date waiver approved
- Waiver approval authority/ID
- Exceeded standards
- Does not meet standards
- Date waiver expires

C. SCIF Management

1. SO Responsibilities:

   a) The SCIF SO shall be responsible for all aspects of SCIF management and operations to include security policy implementation and oversight.

   b) The SO shall prepare a comprehensive Standard Operating Procedure (SOP) that documents management and operations of the SCIF.

   c) The SO shall review the SOP at least annually and revise it when any aspect of SCIF security changes.

   d) The SO shall issue and control all SCIF keys. Locks shall be changed when a key is lost or is believed to be compromised.

   e) The SO shall conduct annual self-inspections to ensure the continued security of SCIF operations, identify deficiencies, and document corrective actions taken. Inspection results shall be forwarded to the AO and copies retained by the SO until the next inspection.

   f) The SO shall create an emergency plan to be approved by the AO. Plans shall be reviewed and updated annually and all SCIF occupants shall be familiar with the plans. Drills shall be conducted as circumstances warrant, but at least annually. The emergency plan may be an extension of an overall department, agency, or installation plan.

      (1) For SCIFs within the U.S., emergency plans shall address the following:

      - Fire
      - Natural disaster
      - Civil unrest
      - Intrusion detection system failures
      - Admittance of emergency personnel
      - The protection of SCIF occupants and classified information
      - Evacuation requirements and emergency destruction

      (2) For SCIFs outside the U.S., emergency plans shall address all of the above and shall include instructions for the emergency destruction or removal of SCI where political instability, terrorism, host country attitudes, or criminal activity suggest the possibility that a SCIF may be overrun.

   g) The SO shall control passwords to access the maintenance mode of copiers and other office equipment.

   h) The SO shall develop an SOP that addresses actions to be taken when IDS maintenance access is required.

2. Required SCIF Documentation

   a) Copies of all documents relating to SCIF accreditation shall be maintained by the SCIF SO and include, but not limited to, the following:

- SCIF accreditation
- Fixed facility checklist
- Construction security plan
- CTTA evaluation
- IS accreditation
- SOPs
- The results of the final acceptance test of the original system installation and any tests to system modifications made thereafter
- Emergency plan

b) As applicable, the following documents shall be maintained by the SCIF SO:

- TSCM reports
- Co-utilization agreements
- Memoranda of agreement
- Self-inspection reports
- Compartmented area checklist
- Shipboard SCIF checklist
- Aircraft/UAV checklist
- A copy of the CRZH certificate (UL 2050)
- Pre-Construction Checklist Form

D. SOPs

1. A comprehensive SOP that documents management and operations of the SCIF shall be prepared by the SO.

2. The SOP shall be included in the accreditation package and approved by the AO.

3. All individuals assigned to, or having unescorted access to, the SCIF shall be familiar with and adhere to the SOP.

4. All SOP revisions shall be provided to the AO for approval.

5. SOPs shall be tailored to a specific SCIF.

6. SOPs shall include specific areas of security concern as defined by program or mission requirements.

7. The following are examples of subjects that should be addressed in an SOP:

- Self-inspections
- Security incidents and violations
- Alarm systems and response requirements
- Opening and closing procedures
- Access controls
- Visitor access
- Escort procedures
- Equipment maintenance procedures

- Handling, processing, and destruction of classified material
- Badge procedures
- End-of-day security procedures
- Personnel and package inspection procedures
- Secure communications device instructions

E. Changes in Security and Accreditation

1. Changes affecting the security posture of the SCIF shall be immediately reported by the SO to the AO to include any corrective or mitigating actions taken.

2. If an AO determines that SCIF security conditions are unsatisfactory, SCIF accreditation may be suspended or revoked.

   a) All appropriate authorities and SCIF occupants shall be immediately notified and the SCIF closed until deficient conditions are corrected.

   b) All SCI material shall be relocated to another SCIF.

F. General

1. Except for law enforcement officials or other personnel required to be armed in the performance of their duties, firearms and other weapons are prohibited in SCIFs.

2. Photography, video, and audio recording equipment are restricted but may be authorized for official purposes as documented in the SOP.

3. Procedures shall be established to control IT storage media upon entering or exiting a SCIF in accordance with ICD 503 (Intelligence Community Information Technology Systems Security Risk Management, Certification and Accreditation).

4. SCIF perimeter doors shall remain closed and controlled at all times. When a door needs to be open, it shall be continually monitored by an SCI-indoctrinated individual.

5. All SCIF occupants shall be familiar with emergency plans and drills shall be conducted as circumstances warrant, but at least annually.

6. Where the risk of hostile action is significant, SCI materials shall be maintained at an absolute minimum.

G. Inspections/Reviews

1. SCIF inspections shall be performed by the AO, or designee, prior to accreditation.

2. The AO, or designee, shall conduct periodic security inspections/reviews to ensure the efficiency of SCIF operations, identify deficiencies, and document corrective actions taken. All relevant documentation associated with SCIF accreditation, inspections, and security administration may be subject to review.

3. Periodic inspections/reviews shall be conducted based on threat, facility modifications, sensitivity of programs, past security performance, or at least every five years.

4. SOs shall conduct annual self-inspections to ensure the continued security of SCIF operations, identification of deficiencies, and to document corrective actions taken. Inspection results shall be forwarded to the AO and copies retained by the SO until the next inspection.

5. Authorized inspectors shall be admitted to a SCIF without delay or hindrance when inspection personnel are properly certified to have the appropriate level of security clearance and SCI indoctrination for the security level of the SCIF.

6. Short-notice or emergency conditions may warrant entry without regard to the normal SCIF duty hours.

7. Government-owned equipment needed to conduct SCIF inspections will be admitted into the SCIF without delay. Specifically, equipment for TEMPEST or Technical Surveillance Countermeasures (TSCM) testing shall be admitted to a SCIF as long as the personnel operating the equipment are certified to have the appropriate level of security clearance and SCI indoctrination.

8. Technical Surveillance Countermeasures (TSCM) activities in SCIFs will only be conducted by USG TSCM teams established or sponsored by a USG element. USG TSCM teams consist of USG military or civilian personnel or USG contractors who have successfully completed approved TSCM training.

H. Control of Combinations

1. Combinations to locks installed on security containers/safes, perimeter doors, windows, and any other opening should be changed in the following circumstances:

   a) When a combination lock is first installed or used.

   b) When a combination has been subjected, or believed to have been subjected, to compromise.

   c) Whenever a person knowing the combination no longer requires access to it unless other sufficient controls exist to prevent access to the lock.

   d) At other times when considered necessary by the SO.

2. When the lock is taken out of service, it will be reset to 50-25-50.

3. All combinations to the SCIF entrance doors should be stored in a different SCIF. When this is not feasible, alternative arrangements shall be made in coordination with the AO.

I. De-Accreditation Guidelines

SCIF closeouts and de-accreditations shall comply with the following procedures:

1. Inspect all areas, storage containers, and furniture for the presence of classified, sensitive, or proprietary information, and remove any found.
2. Reset safe combinations to 50-25-50 and lock the containers.
3. Affix written certification to all storage containers that the container does not contain classified, sensitive, or proprietary information. The certification shall include the date of inspection and the name and signature of the inspector.
4. Ensure that reproduction and printing equipment is decertified or disposed of in accordance with AO guidance.
5. Dispose of, or relocate, SCI computer equipment, media, hard drives, and portable storage media as approved by the AO.
6. Request revocation of Automated Information Systems (AIS) accreditation.
7. Request revocation of SCIF accreditation.
8. If the SCIF will be used for another mission or project that requires alarms, transfer alarm service to the new activity.
9. If the SCIF will not be used for another mission or project and all classified, sensitive, or proprietary information has been removed, the following shall occur:
   a) Alarm service shall be discontinued.
   b) Combinations on the entrance door and any GSA containers shall be changed to 50-25-50.
   c) All keys shall be accounted for.

J. Visitor Access

1. General Requirements
   a) Visitor logs shall be used to record all SCIF visitors and include the following information:
      - Visitor's full name
      - Organization
      - Citizenship
      - Purpose of the visit

- Point of contact
- Date/time of the visit

b) Government-issued identification shall be required as a means of positive identification.

c) Visitor logs shall be retained for two years after the date of the last entry.

d) Visitor clearance verification shall be accomplished using the DNI Scattered Castles database to the greatest extent possible.

e) Visitors whose clearances have not been verified may be permitted, under escort, entry into the SCIF; however, access to and/or discussion of classified information shall be denied pending clearance verification.

f) Visitors, SCIF occupants, and their possessions may be subject to screening and inspections to deter the unauthorized removal of classified material or the introduction of prohibited items or contraband.

g) Screening and inspection procedures shall be documented and approved by the AO.

2. SCIF Access by Uncleared and Emergency Personnel

a) Uncleared personnel shall be escorted at all times by cleared personnel.

b) The ratio of cleared escorts to uncleared personnel shall be determined on a case-by-case basis by the SO.

c) Prior to assuming escort duties, all escorts shall receive a briefing by the SO or designee outlining their responsibilities.

d) Uncleared personnel shall be kept under observation at all times while in the SCIF. Escorts shall ensure precautions are taken to preclude inadvertent access to classified information.

e) Lights, signs, or other alerting mechanisms or procedures shall be used to alert SCIF occupants of the presence of uncleared personnel.

f) Emergency personnel and equipment shall be allowed access to SCIFs and be escorted to the degree practical. If exposed to classified information, they shall sign an inadvertent disclosure statement when feasible.

K. Maintenance

1. SCI-indoctrinated maintenance personnel shall be used to the extent possible.

2. Procedures for performing maintenance on office equipment, including the use of diagnostic equipment, shall be documented in the SCIF SOP.

3. Computerized diagnostic equipment, to include associated hardware and software, shall be kept under control within a SCIF and shall be managed to prohibit the migration of classified data when connected to classified systems. Procedures shall be documented in the SOP.

4. Passwords to access the maintenance mode of copiers and other office equipment shall be controlled by the SO.

5. Office equipment that is no longer serviceable, such as copiers and classified fax machines, shall be sanitized by having volatile memory erased and non-volatile memory and disk storage removed for terminal destruction.

L. IDS and ACS Documentation Requirements

The following documents and records shall be maintained by the SCIF SO:

1. System Plans such as system design, equipment, and installation documentation.

2. If applicable, agreements established for external monitoring, response, or both, and which shall include the following information:

   - Response time for response forces and SCI indoctrinated personnel.
   - Responsibilities of the response force upon arrival.
   - Maintenance of SCIF points of contact.
   - Length of time response personnel are required to remain on-site.

3. Monitoring Station SOP and/or a copy of the monitoring station UL certificate.

4. Maintenance access SOP.

5. Records, logs, and archives.

6. Records of system testing (for two years) shall include the following information:

   - Testing dates
   - Names of individuals performing the test
   - Specific equipment tested
   - Malfunctions detected
   - Corrective actions taken

7. Records of guard or response force personnel testing as required by the AO.

8. The PCU shall contain a secured, non-volatile event (alarm) log capable of storing at least six months of events, or a printer shall be installed that provides real-time recording of openings, closings, alarms, trouble alarms, and loss of communications.

   a) If the system has no provision for automatic entry into archive, the AO may authorize a manual logging system.

   b) Monitoring personnel shall record the time, source, type of alarm, and action taken.

   c) The SCIF SO shall routinely review the historical records.

   d) Results of investigations and observations by the response force shall also be maintained at the monitoring station.

   e) Records of alarm annunciations shall be retained for two years.

   f) Shunting or masking of any zone or sensor shall be logged in the system archives.

   g) All maintenance periods shall be archived into the system.

   h) An archive shall be maintained for all remote service mode activities.

9. Access Control Systems Records which include:

   a) The active assignment of ID badge/card, PIN, level of access, entries, and similar system-related information

   b) Records of personnel removed from the system which shall be retained for two years from the date of removal.

10. Records of security incidents (violations/infractions) regarding automated systems shall be retained by the SO for five years from the date of an incident or until investigations of system violations and incidents have been resolved.

M. Emergency Plan

1. The SO shall create an emergency plan.

2. The emergency plan shall be approved by the AO and maintained on-site for each accredited SCIF.

3. The emergency plan may be an extension of an overall department, agency, or installation plan.

4. The emergency plan shall address the following:

   - Fire
   - Natural disaster
   - Civil unrest
   - Intrusion detection system failures
   - Admittance of emergency personnel into a SCIF
   - The protection of SCIF occupants and classified information

- Evacuation requirements and emergency destruction

5. Plans shall be reviewed at least annually and updated as necessary.

6. All SCIF occupants shall be familiar with the plans and drills shall be conducted as circumstances warrant, but at least annually.

7. Where political instability, terrorism, host country attitudes, or criminal activity suggests the possibility that a SCIF may be overrun, emergency plans shall include instructions for the secure destruction or removal of SCI under adverse circumstances and include contingencies for loss of electrical power and non-availability of open spaces for burning or chemical decomposition of material.

8. Where the risk of hostile actions are significant, SCI holdings and reference materials shall be maintained at an absolute minimum required for current working purposes. If reference or other material is needed, it shall be obtained from other activities and returned or destroyed when no longer needed.

N. SCIF Co-Use and Joint Use

1. Any SCIF that has been accredited by an AO or designee shall be reciprocally accepted for use as accredited by all IC Elements when there are no waivers to the requirements established in ICS 705-1, ICS 705-2 and the IC Tech Specs.

2. Reciprocity is a condition that occurs when there is a requirement to share an accredited SCIF or a portion thereof with a compartment, program or special activity that is sponsored by an IC Element or organization other than the current SCIF CSA.

3. Reciprocal use requires a Co-Use (or Joint Use) agreement (CUA) which:

    -Identifies responsibilities of the tenant and host

    -Identifies the proposed use/activity

4. All CUA require completion of the SCIF Co-Use Request form.

5. CUA are considered Joint Use when the tenant desires to use the host information system.

6. CUA are routed through and approved by designated Co-Use Coordinators. These are the only individuals another Co-Use Coordinator will accept a CUA form from for processing.

7. The burden to initiate a CUA falls to the tenant. Information accuracy in the request is the responsibility of the tenant/host to facilitate; not the CUA coordinator.

8. CUA are NOT required when sharing a SCIF by two or more components under the cognizance of the same IC Element.

9. CUA are coordinated with the Information System security representatives if the tenant intends to bring an IT system into the host SCIF. Joint Use requires Information System security representative coordination as well.

O. CUA Form and Instructions

1. The following provides a guide on required information to ensure a CUA form is completed sufficiently and can be approved by both the tenant and host Co-Use Coordinators. Information accuracy on the form is the responsibility of the tenant and host mission areas to validate prior to the form being routed to the requesting (tenant) Co-Use Coordinator to initiate the approval process.

2. Overall classification of the CUA will usually be to the host security classification guide, unless the tenant mission is a higher classification.

3. All processing of a CUA should use the current form and be conducted on a classified system. Obtain the current CUA form from your agency Co-Use Coordinator. Legacy forms will not be accepted by the Co-Use Coordinator. Information necessary for a complete form includes:

-Block 1: Host Agency/Department

-Block 2: Tenant Agency/Department POC's (POC's are NOT the CUA Coordinator)

-Block 3: Provide complete and accurate information, to include the complete address and SCIF ID; this is how a coordinator validates information. Ensure the room numbers are accurate. This is important for IS installation. Site POC could be someone from host mission area or SO.

-Block 4: Ensure accuracy; one box must be checked.

-Block 5: Ensure accuracy; this is how a coordinator validates information.

-Block 6: This is the Host Information Security POC. Ensure the Co-Use or Joint Use categories and use criteria is accurate and clarified with Tenant/Host before the form is filled out.

-Block 7: Ensure all required information is filled out for an Industry site. Most Government locations are "Indefinite", however IC Elements AO or Designee may have designated time limits.

-Block 8: Most instances are "Intel Related". If you check "Other" ensure that a full and thorough description is provided in Block 9.

-Block 9: Ensure any information is clarified and input here; don't use for "filler". Classify as needed and portion mark properly.

-Tenant/Host Concur Blocks: Do NOT digitally sign; these are for CUA Coordinator use.

-Classification Block: Ensure the document is classified properly and this block is filled out properly; most likely to the Host classification guides.

P. CUA Cancellation

1. When a CUA is no longer desired or necessary a CUA cancellation form is required.
2. The burden to initiate the CUA cancellation form falls to the tenant.
3. The following provides a guide on required information to ensure a CUA cancellation form is completed sufficiently.

-Block 1: Host Agency/Department

-Block 2: Tenant Agency/Department POC's (POC's are NOT the CUA Coordinator)

-Block 3: Provide complete and accurate information, to include the complete address of the facility hosting the CUA/JUA

-Block 4: Ensure the SCIF ID is accurate.

-Block 5: Ensure the room numbers are accurate. This is important for IS removal (if applicable).

-Block 6: Ensure any pertinent information is clarified and input here.

-Tenant CUA Coordinator will digitally sign and date

-Classification Block: Ensure the document is classified properly and this block is filled out properly.

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Chapter 13. Second Party Integree and Second Party Liaison Spaces within U.S. Sensitive Compartmented Information Facilities (SCIF)

A. Applicability:

1. This chapter applies only to U.S. SCIFs where Sensitive Compartmented Information (SCI) -indoctrinated Second Party Integree (2PI) officers or SCI-indoctrinated Second Party Liaison (2PL) officers are permitted access or are assigned workspaces in accordance with authorized U.S. and Second Party agreements.

2. This chapter does not apply to foreign officers other than Second Parties, defined below.

3. The mitigations listed in this chapter shall be coordinated with the other SCIF tenants, as applicable.

B. Definitions:

1. <u>Second Party (also known as Five Eyes)</u>: Australia, Canada, New Zealand, and the United Kingdom.

2. <u>Second Party Integree (2PI)</u>: A Second Party citizen who is employed by a Second Party government who works in support of a United States Government (USG) objective at a USG organization, under the supervision and direction of USG personnel within a USG facility with a co-utilization agreement, or

- A Second Party citizen who works under a USG contract, in support of a USG objective at a USG organization, under the supervision and direction of USG personnel within a USG facility or Second Party facility with a co-utilization agreement.

3. <u>Second Party Liaison (2PL)</u>: A Second Party citizen who is employed by, works in support of a mission of, represents the equities of, and works under the supervision of their government or other foreign entity rather than the USG. These individuals act as immediate points of contact for

official interaction between their government or foreign entity and the USG organization to which they are assigned.

4. Unescorted: An individual unaccompanied or unattended in a space, or otherwise without line of sight observation by a SCI-indoctrinated U.S. person.

5. Non-releasable Information: Includes, but not limited to, all No Foreign National (NOFORN), For Official Use Only (FOUO), or any other program information that is not releasable to foreign nationals.

C. General Guidelines:

1. This chapter establishes procedures for implementing mitigations for the assignment of 2PI and 2PL officers within, or granting of access by 2PI and 2PL officer to IC accredited SCIFs.

2. 2PI and 2PL officers may be given unescorted access, with AO approval, to U.S. SCIFs that contain only information and information systems (IS) that is releasable to them without any additional mitigations.

3. IC elements must adhere to all policy standards and guidance noted below before permitting 2PI and 2PL access or assignment to U.S. SCIFs:

- Intelligence Community Directive (ICD) 704, *Personnel Security Standards and Procedures for Access to SCI*
- Intelligence Community Standard (ICS) 704-02, *Waiver Requests for Access to SCI*
- ICS 503-04, *Managing Non-U.S. Personnel Access to Information Systems*
- ICD 705, *Sensitive Compartmented Information Facilities*
- ICS 705-01, *Physical and Technical Security Standards for Sensitive Compartmented Information Facilities*
- ICS 705-02, *Standards for Accreditation and Reciprocal Use of SCIFs*

- ICD/ICS 705, *Technical Specifications for Construction and Management of SCIFs*

- ES-2016-00816, *Second Party Integree Access to the Intelligence Community (IC) Information Environment*. This chapter establishes procedures for implementing mitigations for the assignment of 2PI and 2PL officers within IC-accredited SCIFs.

At a minimum, and prior to placement, the U.S. host organization will ensure:

a. All 2PI and 2PL officers assigned to U.S. SCIFs have the appropriate security clearance equivalent to Top Secret (TS)/SI/TK
b. Agreements, through which the officer has been authorized, have been executed
c. All necessary approvals, as specified in paragraph D.1, have been received, and mitigations as specified in paragraph D.2 have been implemented

4. All requirements established in ICS 503-04, *Managing Non-U.S. Personnel Access to Information Systems* will be implemented and adhered to. This applies to all U.S. or partnership IS that store, process, or transmit U.S. intelligence information, as defined in ICS 503-04.

5. Every effort will be made to place 2PI officers outside of U.S. SCIF space where non-releasable information or IS is processed, stored, or located.

6. 2PL officers shall not be placed in or given unescorted access to U.S. SCIF space where non-releasable information or IS is processed, stored, or located.

7. 2PI or 2PL officers shall not be placed in or given unescorted access to a U.S. SCIF that also contains open storage of Special Access Program information.

8. 2PI officers shall not be given unescorted access to U.S. SCIFs or SCIF areas in which they do not have assigned workspaces unless that SCIF or SCIF area is the most direct walk-path to their assigned workspace. If the most direct walk-path must transverse these areas, all standards, mitigations, and outlined requirements within this chapter also are extended to any hallways or open SCIF cubicle/work areas that the 2PI must traverse to reach their assigned work location.

9. Intent to permit access, or assign approved 2PI or 2PL officers within an existing accredited U.S. SCIF shall be immediately reported by the Security Officer or Mission Owner to the Accrediting Official (AO), to include any mitigating actions for AO and Authorizing Official, for approval. Chief Information Security Officer (CISO) consultation is recommended. The host agency AO shall notify all co-use tenants in writing at least 30 days prior to the assignment of 2PI or 2PL personnel to the SCIF and provide a list of mitigations that will be implemented to prevent access to non-releasable information for the duration of the 2PI or 2PL's assignment. Co-use tenants are responsible for any additional mitigations above and beyond those mitigations in place or recommended that are particular to the protection of their information. The additional mitigations will be adhered to by any other tenants and by the host if they require access to the tenant's information. 2PI or 2PL officer assignment to the specific SCIF will be annotated in the IC SCIF Repository.

10. If an AO determines that required SCIF security mitigations, as specified in paragraph D.1 and D.2 have not been met or if 2PI or 2PL officers are placed or provided access without the necessary approvals, immediate corrective action is required and may include: exclusion of 2PI or 2PL officers from general or unescorted access to the space; suspension or revocation of SCIF accreditation; removal of all non-releasable information and IS, or; other action as determined by the AO.

11. IC Elements must implement the AO-approved mitigations listed herein within 45 days of issuance of this chapter. SCIF AOs may provide an extension for SCIFs already accredited to allow elements additional time to

implement the listed mitigations. The additional timeline will be determined by the AO.

D. Approvals, Mitigations, and Procedures

This section provides guidance on procedures and mitigations to support placement of TS/SI/TK or equivalent cleared 2PI officers within U.S. SCIFs where non-releasable information or IS are processed, stored, or located.

1. Approvals:

   a. AO approval is required when some or all the mitigations outlined in section D.2.a. are implemented. If mitigations other than those listed in section D.2.a. are implemented or changed, approval by the host IC element head or their designee, and notification to any affected tenants or agencies with co-use agreements is required. Any alternate mitigations must meet the requirement of ICD 705 that SCI be protected from unauthorized disclosure, which includes the unauthorized disclosure of non-releasable information to 2PI officers.

   b. All applicable authorizing officials (e.g., AO and CISO) for non-releasable IS must determine their risk tolerance based on the implemented mitigations. If the SCIF is co-use by other tenants, the authorizing officials from those other agencies also must review the mitigations and determine risk tolerance.

Note: In accordance with ICD 705, waivers must be approved by the IC element head. When approving assignment of 2PI officers within SCIFs the IC element head may only approve waivers and accept risk as it relates to the SCI information processed and IS for which their IC element is responsible. In accredited SCIFs where 2PI have been granted physical access to the space, and where SCI information is processed or IS that belong to more than one IC element are present, all affected elements **must be informed of any waivers**, and decide to accept the risk, remove their systems, or implement additional mitigations as necessary.

In addition, each 2PI or 2PL shall be assigned a Control Officer (CO)/Mission Sponsor (MS) who is responsible for ensuring the 2PI or 2PL does not receive access to any information not authorized as outlined in the Designated Disclosure Letter by the IC element's International Program Office or equivalent. AOs are responsible for documenting 2PI and 2PL and CO/MS assignments and ensuring that the documentation is accessible to all tenants within the SCIF.

2. Mitigations:

a. The AO shall minimize access to non-releasable information by implementing the following mitigations (if applicable):

- Segregating 2PI-releasable and non-releasable areas of the SCIF to the greatest extent practical
- Using access control systems to restrict 2PI access to only those SCIF areas to which they are assigned and/or must traverse on the most direct walk-path to their assigned workspace consistent with their agreements
- Using partitions and/or signs to designate SCIF locations where 2PI officers are assigned or traverse
- Using partitions and signs, or colored tape on the floor to designate U.S.-only areas
- Locking computer screen(s) (throughout the day) or logging out of system(s) (at end of day) and conducting security check of area before departing
- Implementing security education and awareness program(s) with annual refresher training for SCIF occupants

b. Minimize the likelihood of accidental visibility by implementing the following:

- Using polarizing privacy screens
- Positioning computer screens aimed away from doorway, cubicle openings, walk paths, and common spaces

- Positioning non-releasable information or IS away from doorways, cubicle openings, walk-paths, and common spaces, and co-locating non-releasable information or IS with other like compartmented non-releasable or IS
- Using cover sheets for classified information at all times
- Ensuring that all classified information printing/reproduction equipment that processes non-releasable information uses identity verification (e.g., pin to print)
- Implementing clean desk policies and securing non-releasable information when not in use
- Ensuring that discussion of non-releasable information does not takes place in areas where 2PI are assigned or traverse, and placing "no-discussion" signs in prominent places on the walls
- Ensuring equipment with Top Secret video/teleconference capability is located in an authorized space which meets STC 50 (in accordance with ICD/ICS 705, *Technical Specifications for Construction and Management of SCIFs)*, and uses a mitigation to preclude unauthorized use by 2PI personnel (e.g., PIN-enabled)

c. All attempts should be made to separate 2PI office space from U.S. office spaces. To prevent inadvertent disclosure, sound masking devices or sound batting shall be installed between the offices and above false ceilings (in accordance with Chapter 9E). Additionally, office doors shall be closed when discussing non-releasable information if FVEY personnel are present or have access to the area, and speaker phones located in non-enclosed areas shall be disabled.

3. Procedures**:**

a. If appropriate mitigations are implemented and approvals obtained as described in this chapter, the AO may approve:

1) Assigned SCI-indoctrinated 2PI officers to move unescorted to/from their assigned space(s) via designated walk-paths when properly cleared U.S. personnel are present within the workspace.

2) Assigned SCI-indoctrinated 2PI officers to escort SCI-indoctrinated visitors to/from the 2PI assigned work areas only when U.S. SCI-indoctrinated personnel are present in the workspace.

3) Assigned SCI-indoctrinated 2PI officers to escort 2P visitors, who are either uncleared or whose 2P clearance has not been verified, to/from the 2PI officer's assigned work areas only if all of the following are met:

- U.S. SCI-indoctrinated personnel are present in the workspace
- All inhabitants are made aware of visitor presence via auditory or visual means
- The visit duration is limited to one day, unless approved for longer period, at which time the visit shall be revalidated

b. The AO may authorize an SCI-indoctrinated assigned 2PI person to have lock combinations and/or intrusion detection system (IDS) arming/disarming codes of a U.S. SCIF perimeter door only when:

1) There is a validated mission requirement

2) All information and IS processed, stored, or located within the SCIF space are FVEY-releasable, or non-releasable information is stored in a GSA-approved security container when there are not SCI-indoctrinated U.S. personnel present in the workspace

3) All SCIF organizational tenants and agencies with co-utilization agreements with this or any adjacent SCIF have been notified in writing of the 2PI integration and been provided an opportunity to raise concerns.

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APPENDIX C

UFC 4-010-05

SCIF/SAPF PLANNING, DESIGN, AND CONSTRUCTION

26 MAY 2023

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UFC 4-010-05
26 May 2023

UNIFIED FACILITIES CRITERIA (UFC)

SCIF/SAPF
PLANNING, DESIGN, AND
CONSTRUCTION

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UNIFIED FACILITIES CRITERIA (UFC)

SCIF/SAPF
PLANNING, DESIGN, AND CONSTRUCTION

Indicate the preparing activity beside the Service responsible for preparing the document.

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

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

Change No.	Date	Location

This UFC supersedes UFC 4-010-05 Change 1, dated October 2013.

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FOREWORD

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

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

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

- Whole Building Design Guide website https://www.wbdg.org/ffc/dod.

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

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This UFC is intended to provide unified criteria to make the planning, design and construction communities aware of the published regulatory requirements to ensure timely, consistent, and appropriate implementation.

1-2 REISSUES AND CANCELS.

This UFC reissues and cancels UFC 4-010-05, Change 1, 1 October 2013.

1-3 APPLICABILITY.

This document applies to all construction, renovation, and repair projects for DoD Sensitive Compartmented Information Facility (SCIF) or Special Access Program Facility (SAPF). This UFC applies to each phase of a project, from planning through construction.

1-3.1 SCIF.

SCIF is an accredited area(s), room(s) or building(s) where Sensitive Compartmented Information (SCI) is stored, used, processed or discussed. SCIF is only required for SCI and not required for Confidential, Secret or Top Secret information.

1-3.2 SAPF.

A specific physical space that has been formally accredited in writing by the responsible program security officer (PSO) that satisfies the criteria for generating, safeguarding, handling, discussing, and storing classified or unclassified program information, hardware, and materials.

1-4 GLOSSARY.

APPENDIX B contains acronyms, abbreviations, and terms.

1-5 REFERENCES.

APPENDIX C contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of referenced publications applies.

1-6 POLICY.

There are multiple policy documents that establish the baseline requirements for planning, design, construction and accreditation of DoD facilities.

1-6.1 Office of the Director of National Intelligence.

Intelligence Community Directive (ICD) 705 was issued by the Director of National Intelligence (DNI) on May 26, 2010. Intelligence Community Standard (ICS) 705-1, ICS 705-02, and the Intelligence Community (IC) Tech Spec-for ICD/ICS 705 provides the physical and technical security standards for SCIFs, including existing, new construction, and renovations. Refer to ICS 705-1, ICS 705-02, and IC Tech Spec-for ICD/ICS 705 for additional information.

1-6.2 Department of Defense.

- DoDM 5105.21 (Volumes 1-3) are the primary documents associated with SCIFs for the DoD. The manuals are composed of several volumes, each having its own purpose. DoDM 5105.21 volume 2 concerns the physical security of a SCIF and it requires the implementation of Director of National Intelligence (DNI) policies for the protection of SCI and additional requirements.
- DoDM 5205.07 (Volumes 1-4) are the primary documents associated with SAPFs for the DoD. The manual is composed of several volumes, each having its own purpose. DoDM 5205.07 Vol 3 concerns the physical security of a SAPF and it establishes the construction of a SAPF will conform to the equivalent SCIF requirements, as defined in IC Tech Spec-for ICD/ICS 705.
- DoDM 5200.01 volumes 1-3 are the primary document associated with the protection of classified information for the DoD. The manual is composed of several volumes, each having its own purpose. DoDM 5200.01 volume 3 concerns the physical security of a classified information.
- DoDI 5200.48 is the primary document associated with the protection of Controlled Unclassified Information (CUI).

1-7 REGULATORY AUTHORITY.

1-7.1 DoD SCIF Authorities.

The DoDM 5105.21 manuals define the regulatory authorities for DoD SCIF.

1-7.2 Non-DoD SCIF Authorities.

In some cases, the DoD may build a SCIF for Non-DoD agencies. These projects will have an IC designated AO sponsor for each construction or renovation project for the Non-DoD agency.

1-7.3 DoD SAPF Authorities.

The DoDM 5205.07 manuals define the regulatory authorities for DoD SAPF. The special access program facility accrediting official (SAO) is defined as the AO for SAPF.

1-8 IMPLEMENTATION.

Note that this UFC was based on IC Tech Spec-for ICD/ICS 705 Version 1.5.1. When the National Counterintelligence and Security Center adopts a newer version, it will have precedence over the requirements contained in this UFC.

1-8.1 Department of Navy.

Refer to NAVFAC INST 4700.1 for additional policy for Department of Navy projects that include a SCIF. The NAVFAC instruction details various steps accomplished in the planning, design and construction phase of a SCIF including roles and responsibilities.

1-8.2 Department of the Army.

Department of the Army projects that include a SCIF, refer to *SCIF Security, Planning, Design, and Construction Tasks* downloadable at: https://www.wbdg.org/ffc/army-coe/policies-and-guidance-army-design-and-construction/scif-tasks. The task list details various steps accomplished in the planning, design, and construction of a SCIF, including the roles and responsibilities, Per USACE Engineering Regulation 1110-1-8158 Engineering and Design Centers of Expertise Program, for projects containing SCIFs completed by USACE, inclusion of representative(s) from the USACE Protective Design Center as part of the project delivery team is mandatory. For projects executed by any other services, inclusion of the USACE Protective Design Center is optional. Contact information can be found at: https://www.nwo.usace.army.mil/pdc/home/

1-8.3 Department of the Air Force.

Department of the Air Force projects that include a SCIF, the Construction Agency acting on behalf of the AF must utilize their respective task list for the planning, design, construction of SCIFs including the roles and responsibilities. In the rare case where the AF is acting as the DoD Construction Agent, either the NAVFAC or the USACE task list may be used.

1-9 GENERAL BUILDING REQUIREMENTS.

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

1-10 CYBERSECURITY.

All facility-related control systems (including systems separate from a utility monitoring and control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service Implementation Policy.

1-10.1 Mission Critical Facility-Related Control Systems.

Determine facility-related control system categorization in coordination with supported command and mission owner. Incorporate cybersecurity into the mission critical facility-related control systems with a minimum Confidentiality/Integrity/Availability Categorization of Moderate/Moderate/Moderate as indicated in IC Standard 706-02.

1-11 FACILITY CLASSIFICATION.

SCIF and SAPF are classified based on operational requirements. There are various classifications.

1-11.1 Secure Working Area (SWA) or SAP Working Area (SAPWA).

Area where SCI or SAP is handled, discussed, and/or processed but not stored.

1-11.2 Temporary Secure Working Area (TSWA) or Temporary SAP Working Area (TSAPWA).

An accredited area used for the handling, discussing or processing of SCI or SAP information, when use is limited to less than 40 hours per month.

1-11.3 Temporary SCIF (T-SCIF) or Temporary SAPF (T-SAPF).

Established for a limited time to meet tactical, emergency, or immediate operational requirements.

1-11.4 Closed Storage.

An accredited facility where SCI or SAP material is required to be stored in GSA-approved storage containers when not in use. This includes all classified materials, equipment and information.

1-11.5 Open Storage.

An accredited facility in which SCI or SAP information may be openly stored or processed without using a GSA-approved storage container.

1-11.6 Continuous Operation.

An accredited facility staffed and operated 24/7.

1-12 SECURITY IN DEPTH.

Security in Depth (SID) is desired for all SCIF or SAPF and required for locations outside the United States, its possessions or territories. SID is a multilayered approach, which effectively employs human and other physical security measures throughout the installation or facility to create a layered defense against potential threats. The intent of SID is to increase the possibility of detection of potential aggressors prior to compromising the SCI or SAP materials. Per IC Tech Spec for ICD/ICS 705, the primary means to achieve SID include one of the following:

- Located on a Military installation, embassy compound, U.S. Government (USG) compound, or contractor compound with a dedicated response force of U.S. persons.
- Located within a controlled building with separate building access controls, alarms, elevator controls, stairwell controls required to gain access to the buildings or elevators.
- Controlled office areas adjacent to or surrounding the secure area that are protected by an Intrusion Detection System (IDS).
- Located within a fenced compound with access controlled vehicle gate and/or pedestrian gate.

1-13 SECURITY REQUIREMENTS.

ICS 705-1 and IC Tech Spec-for ICD/ICS 705 provide the security standards. Per IC Tech Spec-for ICD/ICS 705, exceeding or not meeting a standard, even when based upon risk, requires an approved waiver.

Waivers are processed and approved in accordance with DoDM 5105.21 Vol 2 for SCIF and DoDM 5205.07 Vol 3 for SAPF.

1-14 SITE SECURITY MANAGER (SSM).

The SSM is responsible for the security aspects of project planning, design and construction. The SSM is also responsible to ensure compliance of all regulatory requirements for the accreditation of the facility. Planners, Project Managers, Design Managers, Designers, and Construction Managers must work closely with the supported command and their designated SSM to determine the requirements for each project and ensure the implementation of the policy based requirements.

Projects with a SCIF and a SAPF may have two different SSMs reporting to two different AOs.

1-15 CONSTRUCTION SECURITY PLAN (CSP).

The CSP documents the security requirements from planning through construction for each project. Per IC Tech Spec-for ICD/ICS 705, a CSP is developed by the SSM and approved by the AO for each project.

Per IC Tech Spec – for ICD/ICS 705, do not award a construction contract without an approved CSP. See DoDM 5105.21 Vol 2 for SCIF and DoDM 5205.07 Vol 3 for SAPF for additional information and for Navy and Marine Corps projects, refer to NAVFAC INST 4700.01.

1-16 INFORMATION SECURITY.

Per ICS 705-1, construction plans and related documents are to be handled and protected in accordance with the CSP. Construction plans and related documents may be publicly releasable, CUI, or if Classification Guide dictates, plans and related documents may require classification. Refer to DoDM 5200.01 Vol 3 for the handling of classified information and DoDI 5200.48 for the handling of Controlled Unclassified Information (CUI).

1-16.1 SCIF Location and Identity.

DoDM 5105.21 Vol 2 states the facility's location (complete address) and identity of a SCIF must be protected at a minimum of CUI. Drawings or diagrams identified as a SCIF may not be posted on an UNCLASSIFIED website, transmitted over the Internet without some type of encryption or included on public releasable documents. Therefore, do not identify SCIF locations on planning or construction documents. With SSM's approval, areas may be identified as "Restricted Area". "Controlled Space", "Secure Area", "Controlled Area" or some other non-identifiable name.

1-16.2 SAPF Location and Identity.

Similar to SCIF, coordinate with the SSM on how to identify SAPF locations on planning or construction documents. With the SSM's approval, areas may be identified as "Restricted Area", "Controlled Space", "Secure Area", "Controlled Area" or some other non-identifiable name.

1-16.3 TEMPEST Vulnerabilities and Recommended Countermeasures.

TEMPEST vulnerabilities and recommended countermeasures are classified at a minimum of CONFIDENTIAL when associated with a physical location. A TEMPEST vulnerability or countermeasure associated with a SCIF ID number or in a manner that cannot be connected to the physical location is UNCLASSIFIED[1].

1-16.4 Security Environment Threat List (SETL) Information.

The SETL and its contents including a country's threat category is classified Secret.

1-17 DESIGN SECURITY.

Per IC Tech Spec – for ICD/ICS 705, design must be performed by U.S. companies using U.S. citizens or U.S. persons. AO must ensure mitigations are implemented when using non-U.S. citizens and these mitigations are documented in the CSP.

1-18 CONSTRUCTION SECURITY.

Depending on the location of the facility, the AO may impose procedures for the procurement, shipping, selection, and secure storage of construction materials. In

[1] DoDM 5105.21 Vol 2

addition, there may be site security and access control that may include vehicle and personnel inspections. The CSP documents the security requirements for each project. For reference, DoDM 5105.21-Volume 2 and DoD M5205.07 Volume 3 provide additional information on security requirements for DoD SCIF and SAPF construction projects.

1-18.1 Within the United States.

For facilities located within the U.S., its possessions or territories, general construction of the SCIF or SAPF must be performed by U.S. companies using U.S. citizens or U.S. persons. The AO must ensure mitigations are implemented when using non-U.S. citizens. These mitigations must be documented in the CSP.

Per IC Tech Spec – for ICD/ICS 705, Intrusion Detection System (IDS) installation and testing must be performed by U.S. companies using U.S. citizens. However, 5200.01, Volume 3 requires that the alarm installation and maintenance for IDS that protect classified information be accomplished by U.S. citizens who have been subjected to a trustworthiness determination.

1-18.2 Outside the United States.

For facilities located outside the U.S., its possessions or territories, general construction of the SCIF or SAPF must be performed using U.S. companies using U.S. citizens.

- On military facilities, the AO may authorize foreign national citizens or companies to perform general construction. In this situation, the SSM must prescribe, with AO approval, mitigating strategies. These mitigations must be documented in the CSP.
- U.S. Top Secret-cleared personnel must perform finish work in Category I and II countries. U.S. Secret-cleared personnel must perform finish work in Category III countries. Finish work includes activities such as closing up wall structures; installing, floating, taping and sealing wallboards; installing trim, chair rail, molding, flooring; acoustical ceiling tile, light fixtures, device plates, diffusers, registers, grilles, and painting.
- IDS installation and testing must be performed by personnel who are U.S. Top Secret-cleared or U.S. Secret-cleared and escorted by SCIF or SAPF personnel.

1-19 ACCREDITATION.

Accreditation is a formal process to ensure that a facility has been designed, constructed, inspected, and certified to operate in accordance with the provisions of ICD 705. Refer to DoDM 5105.21, Vol 2 and DoDM 5205.07 Vol 3 for the DoD policy on accreditation.

1-19.1 Accreditation Process.

Inspections and evaluations are typically performed by the SSM, or designee, prior to initial accreditation. The accreditation process includes, site inspections and a review of documents relating to design, construction, and testing. The SSM is responsible for assembling and submitting documents for AO approval. The forms for these documents are included in the IC Tech Spec – for ICD/ICS 705. These documents include, but are not limited to the following:

- Construction Security Plan
- Fixed Facility Checklist
- TEMPEST Addendum
- Pre-Construction Checklist

Planners, Designers of Record, Project Managers, and Construction Mangers must provide the SSM the project information needed to develop these documents to support the accreditation process. Information may include, site plans, floorplans, IDS plans, and information related to construction methods and materials.

1-19.2 Fixed Facility Checklist (FFC).

The FFC is a standardized form that documents the physical, technical, and procedural security information to obtain accreditation. This document may be CUI or Classified depending on contents.

1-19.3 TEMPEST Addendum.

The requesting command's Special Security Officer (SSO) or SSM will use the TEMPEST addendum to the FFC, sometimes referred to as the TEMPEST Checklist to request the TEMPEST Countermeasures Review (TCR) by the Certified Technical TEMPEST Authority (CTTA). For an initial TCR, the addendum will be submitted to AO during the planning phase[2]. While some specific information may not be known prior to construction, as much information as possible must be provided in order to minimize costly changes.

The CTTA will provide the TCR based on the TEMPEST addendum and recommend countermeasures to the AO as part of the accreditation process.

1-19.4 Pre-Construction Checklist.

The Pre-Checklist provides the AO with project information, points of contact and information required to assist in the determination of the security requirements for the project and final accreditation.

1-20 HISTORIC PRESERVATION COMPLIANCE.

[2] DoDM 5105.21 Vol 2

1-20.1 Security and Stewardship.

The Department of Defense remains the lead federal agency in balancing security threats with the protection of historic properties. The Department of Defense abides by federal legislation on protecting cultural resources, and issues its own complementary policies for stewardship.

1-20.2 Compliance with Laws.

Implementation of ICD 705 will not supersede DoD's obligation to comply with federal laws regarding cultural resources to include the National Historic Preservation Act (NHPA) and the Archaeological Resources Protection Act (ARPA). Installation personnel must determine possible adverse effects to historic structures and/or archaeological resources during project development and consult accordingly. Personnel at installations outside the United States should coordinate with the applicable host nation regarding possible adverse effects to cultural resources.

1-20.3 Compliance with DoD Standards.

Conversely, historic preservation compliance does not negate the requirement to implement other Department of Defense policy. Federal agencies are always the decision-maker in the Section 106 process of the National Historic Preservation Act. An agency should seek to avoid prolonged consultations that conflict with the imminent need to implement security requirements. Preservation considerations and security standards are not mutually exclusive, and any compliance conflicts should be quickly and effectively resolved in consultation with appropriate stakeholders.

1-21 SECURITY ENGINEERING UFC SERIES.

This UFC is one of a series of security engineering unified facilities criteria documents that cover minimum standards, planning, preliminary design, and detailed design for security and antiterrorism. The manuals in this series are designed to be used sequentially by a diverse audience to facilitate development of projects throughout the design cycle. The manuals in this series include the following:

1-21.1 DoD Minimum Antiterrorism Standards for Buildings.

UFC 4-010-01 establishes standards that provide minimum protection against terrorist attacks for the occupants of all DoD inhabited buildings. This UFC is intended to be used by security and antiterrorism personnel and design teams to identify the minimum requirements that must be incorporated into the design of all new construction and major renovations of inhabited DoD buildings and inhabited tenant buildings on DoD installations. They also include recommendations that should be, but are not required to be incorporated into all such buildings.

1-21.2 Security Engineering Facilities Planning Manual.

UFC 4-020-01 presents processes for developing the design criteria necessary to incorporate security and antiterrorism into DoD facilities and for identifying the cost implications of applying those design criteria. Those design criteria may be limited to the requirements of the minimum standards, or they may include protection of assets other than those addressed in the minimum standards (people), aggressor tactics that are not addressed in the minimum standards, or levels of protection beyond those required by the minimum standards. The cost implications for security and antiterrorism are addressed as cost increases over conventional construction for common construction types. The changes in construction represented by those cost increases are tabulated for reference, but they represent only representative construction that will meet the requirements of the design criteria. The manual also addresses the tradeoffs between cost and risk. The Security Engineering Facilities Planning Manual is intended to be used by planners as well as security and antiterrorism personnel with support from planning team members.

1-21.3 Security Engineering Facilities Design Manual.

UFC 4-020-02FA provides interdisciplinary design guidance for developing preliminary systems of protective measures to implement the design criteria established using UFC 4-020-01. Those protective measures include building and site elements, equipment, and the supporting manpower and procedures necessary to make them all work as a system. The information in UFC 4-020-02FA is in sufficient detail to support concept level project development, and as such can provide a good basis for a more detailed design. The primary audience for the Security Engineering Design Manual is the design team, but it can also be used by security and antiterrorism personnel.

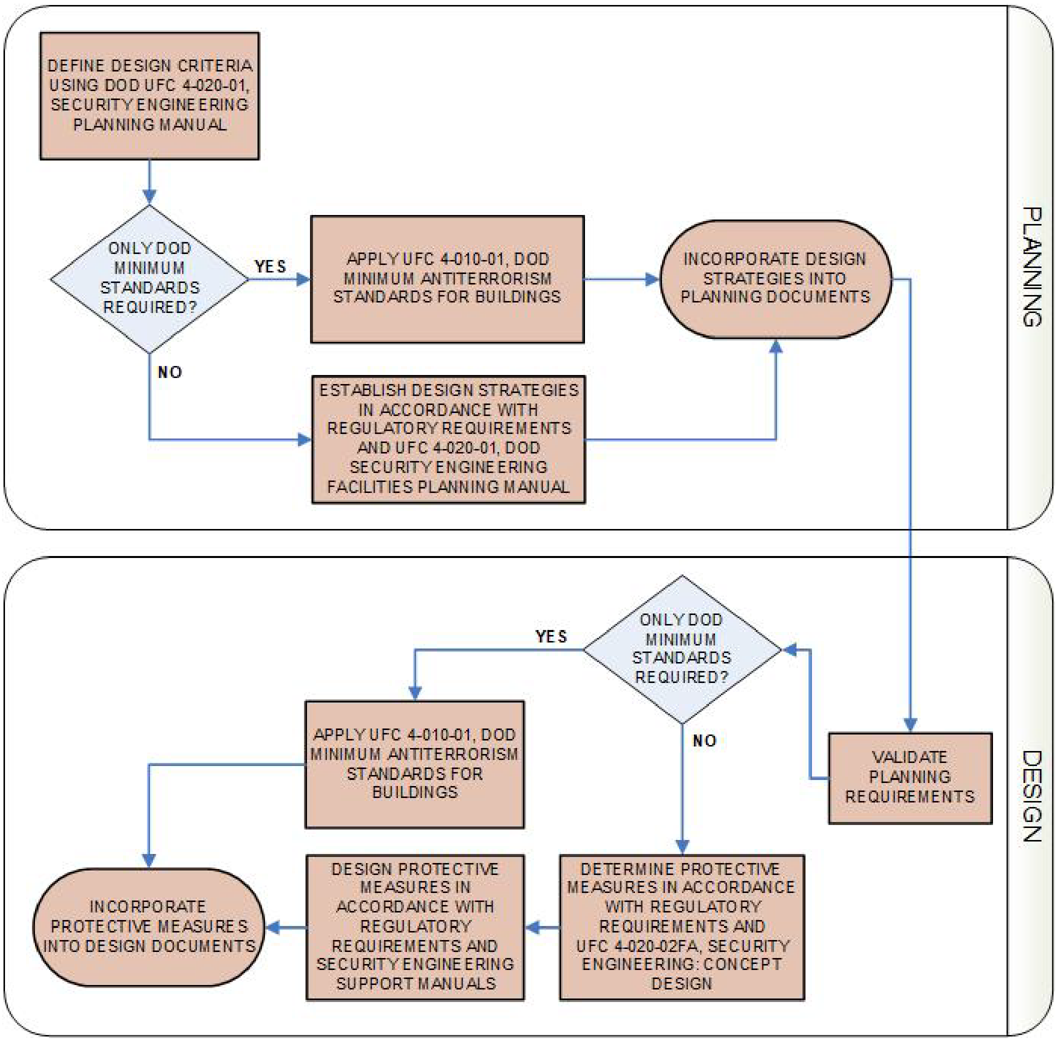
1-21.4 Security Engineering Support Manuals.

In addition to the standards, planning, and design UFCs mentioned above, there is a series of additional UFCs that provide detailed design guidance for developing final designs based on the preliminary designs developed using UFC 4-020-02FA. These support manuals provide specialized, discipline specific design guidance. Some address specific tactics such as direct fire weapons, forced entry, or airborne contamination. Others address limited aspects of design such as resistance to progressive collapse or design of portions of buildings such as mail rooms. Still others address details of designs for specific protective measures such as vehicle barriers or fences. The Security Engineering Support Manuals are intended to be used by the design team during the development of final design packages.

1-21.5 Security Engineering UFC Application.

The application of the security engineering series of UFCs is illustrated in Figure 1-1. UFC 4-020-01 is intended to be the starting point for any project that is likely to have security or antiterrorism requirements. By beginning with UFC 4-020-01, the design criteria will be developed that establishes which of the other UFCs in the series will need to be applied. The design criteria may indicate that only the minimum standards need to be incorporated, or it may include additional requirements, resulting in the need for application of additional UFCs. Applying this series of UFCs in the manner illustrated in Figure 1-1 will result in the most efficient use of resources for protecting assets against security and antiterrorism related threats.

Figure 1-1 Security Engineering UFC Applicability



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CHAPTER 2 PLANNING

2-1 ESTABLISH PLANNING REQUIREMENTS.

This chapter is intended to make planners aware of requirements that may affect the facility scope and budget. It is not intended to document the standard planning processes related to project development.

2-2 CONCEPT APPROVAL.

SCIFs and SAPFs are established when there are clear operational requirements that are critical to the supported command's mission. All projects begin with an AO's sponsorship. This sponsorship is formalized for SCIF and some SAPFs with the Concept Approval.

2-2.1 SCIF Concept Approval.

Per DoDM 5105.21 Vol 2, to establish a SCIF, the supported command must have Concept Approval. The Concept Approval is the first critical element in the establishment of a SCIF. For approval, the commander must submit a request for SCI to the Service Cognizant Security Authority (CSA), their designee, or DoD Component senior intelligence official (SIO). This is referred to as the request for Concept Approval. Concept Approval certifies that a clear operational requirement exists for the SCIF and there is no existing SCIFs to support the requirement. Proof of sponsorship in the form of a SCIF number or written documentation of Concept Approval from the supported command is required to establish a SCIF.

2-2.2 SAPF Concept Approval.

DoDM 5205.07 Vol 3 does not require Concept Approval for SAPF. Sponsorship for most SAPFs is formalized at the program level.

2-2.2.1 Navy SAPF Concept Approval.

Per DONSAPCO/0779-22 Memo, Director, Department of the Navy Special Program Central Office requires Concept Approval for the establishment of a SAPF. The organization with the requirement for the SAPF submits a concept request endorsed by the leadership of the organization via the Program Security Officer (PSO) and the Government Program Manager (GPM). The concept request must clearly define the operational requirement and identify why existing SAPFs do not meet the need. In addition, the organization is required to identify a Site Security Manager (SSM) for the project.

2-3 MINIMUM AND ENHANCED SECURITY.

ICS 705-1 and IC Tech Spec-for ICD/ICS 705 provide the minimum security standards. The security requirements are based on classification, location, and risk assessment of the facility. APPENDIX A provides an overview of the minimum construction requirements. To implement security enhancements above the minimum, the AO will evaluate the threat, SID and balance the security enhancements with cost at acceptable risk.

2-4 PLANNING TEAM.

Establish an interdisciplinary planning team with local considerations. The interdisciplinary planning team must work together to determine classification of the space and establish the minimum/enhanced security requirements. The planning team may consider user constraints such as operations, manpower requirements or limitations, and sustainment costs when determining the requirements for the overall security solution. The planning team should include the following:

- Planning
- Supported Command
- SSM(s)
- Communications
- Security
- Engineering
- Cultural resources (if historical building)

Some teams may require more than one SSM if the facility includes a SCIF and SAPF.

2-5 PLANNING DOCUMENTATION.

The classification, operation, security requirements, TEMPEST countermeasures, and resulting facility related requirements must be scoped, documented, and budgeted during the planning process. Concept Approval, Preliminary CSP, FFC and TEMPEST Addendum are prepared by the SSM and submitted during the planning phase. These documents define the baseline requirements for the project. For Navy and Marine Corps projects, refer to NAVFAC INST 4700.01 for additional information.

2-6 CONSOLIDATION OF SPACES.

When a facility has more than one SCIF or SAPF, serious consideration must be given to consolidating the multiple spaces into one with Compartmented Areas within. Any consolidation of spaces will reduce initial infrastructure and electronic security systems, associated accreditation requirements, and sustainment. Coordinate consolidation with the supported command to ensure the configuration meets command’s operational (compartmented) requirements.

2-7 VISITOR CONTROL.

Some larger facilities may require additional space at the entrance for processing and visitor control. Program adequate space for processing un-indoctrinated personnel and visitors, issuing badges and space for personnel awaiting escorts.

2-8 PRIMARY ENTRANCE VESTIBULE.

Program space for a vestibule at the primary entrance. Vestibules enhance the security of the space by precluding visual observation into the space and enhancing acoustic protection.

2-9 TELECOMMUNICATION SPACES.

Per UFC 3-580-01, the minimum size for a Telecommunications Room (TR) is 10 feet x 8 feet (3m x 2.4m). This and the normal net to gross calculation may be inadequate if the TR contains equipment racks for multiple networks such as Secret Internet Protocol Router Network (SIPRNet), Joint Worldwide Intelligence Communications System (JWICS), Non-classified Internet Protocol Router Network (NIPRNet) and voice services. Depending on the number of workstations served, this could generate a larger space requirement when considering RED/BLACK separation requirements.

UFC 3-580-01 allows the use of Equipment Room in lieu of a TR for buildings that house substantial Information Technology (IT) electronics. A telecommunication space that contains equipment for multiple classified networks such as SIPRNet, JWICS and NIPRNet all requiring RED/BLACK separation is considered as substantial Information Technology (IT) electronics which would allow for the use of the larger Equipment Rooms.

2-9.1 Temperature and Humidity Control.

Substantial Information Technology (IT) equipment generate a significant amount of heat. In these environments, the heat densities can be up to five times higher than in a typical office load. Traditional HVAC systems cannot remove enough heat to protect this equipment. Instead, these areas require dedicated computer room air conditioner (CRAC) units with higher cooling capabilities. The smallest high-powered CRACs require a minimum 10 ft. x 3 ft. (3m×1m) footprint for equipment and clearances. This area must be included in the equipment room area calculation.

2-10 RESILIENCY.

Some critical operations or communication systems may require redundant utilities, standby power, and redundant systems to ensure continuous operation in the event of utility or equipment failure. Coordinate system and the associated resiliency requirements with the mission commander.

2-10.1 Redundant Utilities.

Critical operations or communication systems may require redundant utilities such as telecommunication system connectivity and utility power services. To be redundant, they must be two separate utilities that are not routed together.

2-10.2 Standby Power Systems (SPS).

Critical operations or Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR) systems may require an SPS designed to ensure continuity of electrical power to essential and uninterruptible loads upon loss of normal power sources.

2-10.2.1 Engine-Driven Generator.

When a SPS is required, provide a standby engine-driven generator sized for essential and uninterruptible loads to ensure continued operation upon loss of utility power.

2-10.2.2 Uninterruptible Power System (UPS).

When a SPS is required, provide UPS for the uninterruptible loads to filter commercial power and to support the uninterruptible loads during transitions to and from the standby generator.

2-10.3 Redundancy.

Some critical operations may require a minimum of N+1 redundancy to ensure system availability in the event of component failure. In this configuration, components (N) have at least one independent backup component (+1). An example would be chillers, CRACs, or generators.

2-11 HISTORIC PRESERVATION.

Preservation of Cultural Resources must be considered when converting a historical building into a secure facility or locating a secure space or room within a historic building. For instance, every effort should be made to minimize or eliminate windows, especially on the ground floor. Windows less than 18 feet above the ground or from the nearest platform affording access to the window (measured from the bottom of the window) and doors must be protected against forced entry and meet the standard for the perimeter, which may include acoustic and TEMPEST mitigation. State Historic Preservation Officers (SHPO) may consider window and door modifications to have an adverse effect but allow the modification if the impact is minimized and the effect mitigated. Planners need to explore options and consult with the State Historic Preservation Office (SHPO) to determine options that meet security requirements and are compatible with the Secretary of the Interior's Standards for Rehabilitation.

2-12 CONSTRUCTION SECURITY.

For locations outside the United States, its possessions or territories, the AO may impose procedures for the procurement, shipping, and storing of construction materials at the site. In addition, the AO may require access control to the construction materials and the construction area. These requirements and others are documented in the CSP. Since these additional security measures may have significant cost impacts on a project, they must be determined during project development and documented in the CSP, project planning documents, and the costs must be included in the project budget.

2-13 PROJECT DOCUMENTATION.

Work with the Supported Command, and the SSM to determine and document the classification, operation, and resulting facility requirements for the project. Projects in higher threat areas (outside the United States, its possessions or territories) may have additional security requirements. Determine and document the following during project development:

- Is the SCIF or SAPF the entire facility or an area within the facility?
- Will there be more than one SCIF or SAPF in the facility, if so how many?
  - If more than one, can they be consolidated?
- What is the classification of each space?
- Will the perimeter wall be standard, enhanced, or vault construction?
- What is the required Sound Transmission Class (STC) rating for the perimeter?
- Will there be Compartmented Areas? If so, how many?
  - Is there a STC requirement for the compartmented areas?
- Are there any Electronic Security System (ESS) requirements above that required by IC Tech Spec-for ICD/ICS 705?
- In addition to non-classified Internet Protocol Router Network (NIPRNet) and voice services, what networks such as Secret Internet Protocol Router Network (SIPRNet) or Joint Worldwide Intelligence Communications System (JWICS) that will be processing National Security Information (NSI) be required?
  - Multiple networks will require equipment rooms in lieu of standard telecommunication rooms.
  - Has area been allotted for multiple equipment racks with future expansion, RED/BLACK separation, and CRAC units within the telecommunication spaces?
    - The smallest high-powered CRACs require a minimum 10 ft. x 3 ft. (3m×1m) footprint for equipment and clearances.
- Will operations require redundant utilities such as utility power or telecommunications system connectivity?
- Will operations require standby generator and UPS for continuity of operations?
- Will operations require some level of resiliency such as N+1 chillers, CRACs or standby generators?

- Has the supported command provided the CTTA with a completed TEMPEST Addendum for the TCR?
    - If so, what will be the required TEMPEST countermeasures? RED/BLACK separation, shielding, or filters?
- Are there special procurement, shipping, and storage of construction materials required at the site? If so, what will be required?
- Are there access control requirements for the construction site?
- Are there access control and storage requirements for the construction materials?
- Will U.S. companies using U.S. citizens or U.S. persons be required for construction?
- For projects outside the United States, its possessions or territories:
    - Will U.S. Secret or U.S. Top Secret cleared personnel be required to perform finish work?
    - Will installation and testing of the ESS be performed by U.S. TOP SECRET-cleared personnel or escorted U.S. SECRET-cleared personnel?
- Will any mitigations or countermeasures above the minimum be required?
    - If so, is there an approved waiver?
- Some of these requirements are documented in the CSP. Therefore, it is very important to obtain the preliminary CSP during project development to ensure appropriate security requirements are documented and included in the project scope and budget.

CHAPTER 3 DESIGN

3-1 VALIDATE PLANNING REQUIREMENTS.

Work with the Supported Command and the SSM to validate the requirements established in the planning phase. Operation, classification, and threat classification may have changed since the project was planned. Validate and document the classification, operation, and resulting facility requirements documented in the CSP. Include requirements in the Design Build RFP, design documents, and construction contracts.

3-2 MINIMUM AND ENHANCED SECURITY.

ICS 705-1 and IC Tech Spec-for ICD/ICS 705 provide the minimum and enhanced security standards. APPENDIX A provides an overview of the minimum construction requirements. Per IC Tech Spec-for ICD/ICS 705, exceeding a standard, even when based upon risk, requires a waiver. Planners may have to provide the cost associated with exceeding a standard to include in the evaluation process.

Waivers are processed and approved in accordance with DoDM 5105.21 Vol 2 for SCIF and DoDM 5205.07 Vol 3 for SAPF.

3-3 GENERAL DESIGN STRATEGY.

The general design strategy for any tactic is the basic approach to developing a protective system to mitigate the effects of that tactic. It governs the general application of construction, building support systems, equipment, manpower, and procedures.

The design will vary depending on type, location, SID, risk assessment, and National Security Information (NSI) processing, storage and discussion requirements. Designers must take a six-sided approach when designing a secure space. Design the floor, ceiling, walls and any penetrations to meet the performance requirements for the perimeter.

3-3.1 Consolidation of Spaces.

When a facility has more than one SCIF or SAPF, serious consideration must be given to consolidate the multiple spaces into one. Any consolidation of spaces will reduce initial infrastructure, electronic security systems, associated accreditation requirements, and sustainment costs. Coordinate consolidation with the supported command to ensure the configuration meets command's operational and compartmented requirements.

3-3.2 Perimeter.

The perimeter includes perimeter walls, ceiling, floor, and all penetrations in the perimeter such as windows, doors, ducts and utilities. At a minimum, the perimeter provides:

- Resistance to forced entry
- Resistance to covert entry
- Visual evidence of surreptitious penetration
- Resistance to visual observation
- Sound Attenuation for acoustic eavesdropping
- Countermeasures for Electronic Emanations -TEMPEST (when required)

This includes above the false ceilings and below raised floors.

3-3.3 Building Layout.

To optimize the building layout for security and function, the designer must understand the various secure spaces in the facility, the security clearances of the occupants, visitor access, escort requirements, and the separations or adjacencies required. This takes an integrated design approach that balances the occupant's operational requirements, space requirements, visitor control, security-in-depth and the concept of zoning.

3-3.3.1 Zoning.

Zoning is the concept of grouping functional areas by security or access levels to enhance security. If configured correctly, having multiple zones within a facility can enhance the security of the higher security zones. This is accomplished by requiring personnel to transition through increasingly secure access control layers (zones) prior to accessing the highest security zone. Zones may include public access, controlled access, and restricted access, which can be related to public/visitor areas, service areas, controlled access areas, secret open storage, top secret open storage, SCIF or SAPF. See Figure 3-1 for access layers and Figure 3-2 for a bubble diagram example.

Figure 3-1 Access Layers

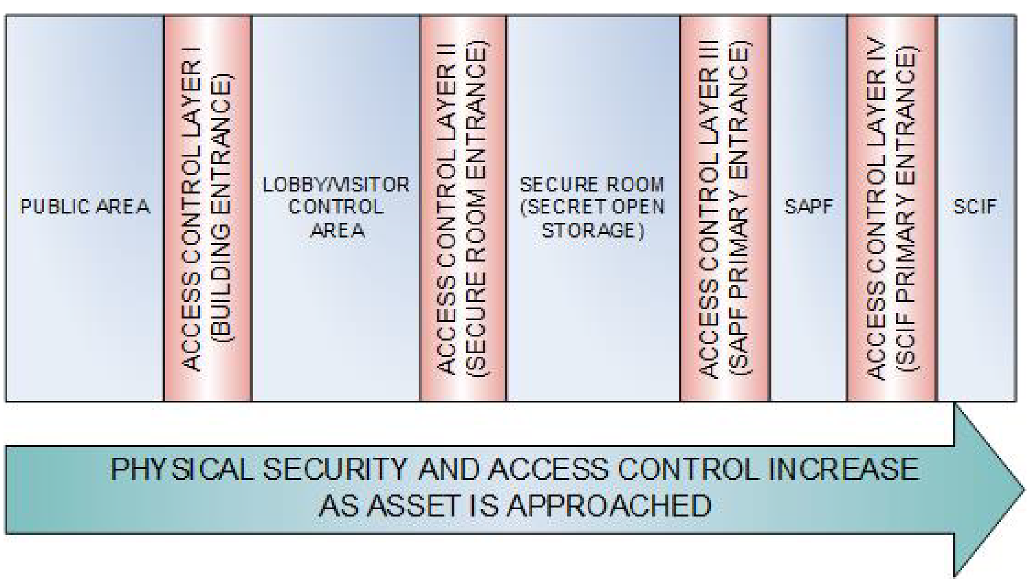
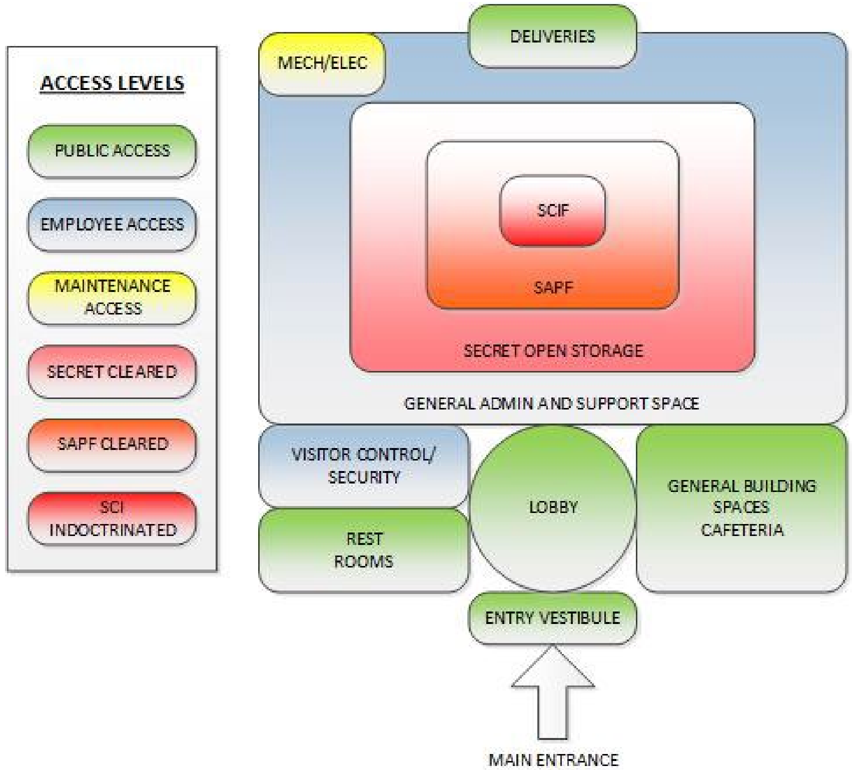


Figure 3-2 Security Zones



3-3.3.2 Layout Criteria.

In developing the building layout:

- Maximize the vertical and horizontal separation between the lowest and highest security areas.
- Maximize grouping of secure areas to enhance floor/ceiling security and to minimize locations of secure elements.
- In large facilities, the highest security area should be located in the building center, upper floor or basement.
- When a facility has multiple security levels, access to the highest security area should be through the area with the next lower security level. An example would be access to the SCIF through a SAPF or secret open storage area.
- Are foreign nationals allowed in the facility to work or participate in training given at the facility? If so, building layout should consolidate high security areas and provide the appropriate separation to minimize the technical threat and escort requirements.
- Utilities and general building support spaces should remain outside of the secure areas.

- Locate telecommunication spaces that contain the encryption equipment within or adjacent (shared wall) to the secure area to enhance security and minimize or eliminate Protected Distribution System (PDS) requirements.
- Entry into a lower security area cannot be through a higher security area. This would require escorts.
- Egress paths from the lower security areas must not pass through a higher security area.
  - Egress stairs intended for use as communicating stairs between secure areas must have appropriate access control at each floor level without compromising safe egress to grade from all floor levels.
  - Vertical circulation elements that are entirely within the secure area may not require additional controls at each landing.

3-3.3.3 Adjacent Space.

To increase SID, locate other areas that require access control adjacent to or surrounding the SCIF or SAPF.

3-3.3.4 Visitor Control.

Some larger facilities may require additional space at the entrance for processing and visitor control. For these facilities, provide adequate space for processing un-indoctrinated personnel and visitors, issuing badges and space for personnel awaiting escorts.

3-4 SPECIFIC DESIGN STRATEGY.

The specific design strategy for any tactic governs how the general design strategy varies for different levels of protection or threat severity. They may vary by the sophistication of the protective measures and the degree of protection provided. The specific design strategies reflect the degree to which assets will be left vulnerable after the protective system has been employed.

3-4.1 Perimeter Construction.

The secure area perimeters and the penetrations in those perimeters are the primary focus of the design and construction. IC Tech Spec-for ICD/ICS 705 provides the minimum and enhanced construction requirements for the perimeter with regard to forced entry, covert entry, visual evidence of surreptitious penetration, and sound attenuation. In addition, radio frequency (RF) shielding and other TEMPEST mitigation must be provided as documented in the TCR. Refer to Best Practices Guidelines for Architectural Radio Frequency Shielding for standard construction for RF shielding.

IC Tech Spec-for ICD/ICS 705 includes suggested construction details for acoustic wall construction and duct penetrations. Designers must ensure that details used from IC

Tech Spec-for ICD/ICS 705 comply with UFC 1-200-01. For example, IC Tech Spec-for ICD/ICS 705 has a suggested wall detail for Wall C - enhanced construction utilizing plywood. However, plywood used for construction of interior partitions must be Fire Retardant Treated (FRT) in buildings required to be of noncombustible construction.

3-4.1.1 Inspectable Perimeter.

Secure space perimeters, including the perimeter above the ceiling or below raised floors may need to be inspected for surreptitious penetration once a space becomes operational. The design should facilitate future inspections by minimizing the above ceiling obstructions on the controlled and uncontrolled side of the secure perimeter. Where hard ceilings are located adjacent to the perimeter, coordinate inspection methods with the SSM and SSO to ensure the capability of above ceiling or below raised floors inspections.

3-4.2 Compartmented Area.

A Compartmented Area may be an area, room, or a set of rooms within the accredited space that provides controlled separation between control systems, compartments, sub-compartments, or Controlled Access Programs. There are three types of compartmented areas. Type I is an area where discussion is not authorized so there is no sound rated construction required. Type II & III are a room, or set of rooms are constructed the same and require acoustic protection.

The design and layout of Type II & III Compartmented Areas is a critical element of the layout of the facility when acoustic protection is required for individual rooms within the space. Compartmented Areas, their type, and adjacencies must be identified early in the design process.

- Acoustic Z-Ducts can increase the above ceiling space requirement
- Sound baffles can significantly affect the HVAC system design due to the increase in backpressure.

3-4.3 Acoustic Protection.

The perimeter of the space must provide acoustic protection. The acoustic protection is intended to protect conversations from being inadvertently overheard outside the secure space, not to protect against deliberate interception of audio.[3]

3-4.3.1 Sound Transmission Class (STC).

The ability of an assembly to retain sound within the perimeter is rated using a descriptive value, the Sound Transmission Class (STC). Architectural Graphics Standards (AGS) established Sound Groups 1 through 4, of which Groups 3 and 4 are

[3] IC Tech Spec – for ICD/ICS 705

considered adequate for specific acoustical security requirements for construction. Per AGS:

- Sound Group 3 – (STC of 45) or better. Loud speech can be faintly heard but not understood. Normal speech is unintelligible.
- Sound Group 4 – (STC of 50) or better. Very loud sounds, such as loud singing, brass musical instruments or a radio at full volume, can be heard only faintly or not at all.

IC Tech Spec – for ICD/ICS 705 provides definitions for Sound Group 3 and 4 based on the above descriptions from AGS.

3-4.3.2 Sound Attenuation Descriptions.

The amount of sound energy reduction may vary according to individual facility requirements. However, Sound Group ratings will be used to describe the effectiveness of acoustical security measures afforded by various wall materials and other building components.

- A minimum of Sound Group 3 (STC 45 or better) for the perimeter unless additional protection is required for amplified sound[3]. This applies to the entire perimeter of the space to include walls, ceilings and floors and perimeter penetrations such as conduit, pipe, ducts, doors, and windows.
- Conference rooms or other areas where amplified audio is used such as video teleconference (VTC) equipment, audio visual systems, and speakerphones must meet Sound Group 4 (STC 50 or better)[3].

3-4.3.3 Minimum Perimeter STC Rating.

The SSM develops the CSP and recommends the STC rating for the perimeter with approval by the AO. The STC ratings for the perimeter should be either STC 45 or STC 50. When factory tested in accordance with ASTM E90, provide assemblies that are no less than STC 50 when STC 45 perimeter is required and no less than STC 55 when STC 50 perimeter is required. This will ensure the assemblies meet the minimum STC requirement when installed correctly. Most factory tests are conducted on assemblies with framing members spaced at 24” (607 mm) on center (o.c.). The spacing of the framing member may be reduced to 16” (406 mm) o.c. without compromising the STC rating[4].

3-4.3.4 Sound Masking.

When normal construction and baffling measures have been determined to be inadequate to meet the sound attenuation requirement, utilize sound masking. See IC Tech Spec for more information on the use of sound masking systems and devices.

[4] GA-600

3-4.4 Perimeter Walls.

SSM, with AO approval, will determine if the perimeter walls are Standard (Wall A), Enhanced (Wall B or C) or vault construction. Walls must go from floor slab (true floor) to underside of floor or roof deck (true ceiling). Perimeter walls, floor and ceiling must be permanently and solidly constructed and attached to each other. Seal partition continuously with acoustical sealant (both sides) and finished to match wall wherever it abuts another element such as the floor, ceiling, wall, or column.

Exception: When an existing wall is constructed with substantial material such as brick, concrete, masonry, the existing wall may be utilized to satisfy the specification[5].

3-4.4.1 Perimeter Wall Variations.

The IC Tech Spec-for ICD/ICS 705 included suggested wall drawings for Standard (Wall A), Enhanced (Wall B or C) and construction criteria for STC 45 and 50 walls. These are suggested and allow variations in wall construction techniques to meet the security standards.

There are criteria beyond the scope of the IC Tech Spec-for ICD/ICS 705 that require walls that may exceed the IC Tech Spec-for ICD/ICS 705. For example, the size of stud and gauge of the metal stud will vary depending on if this is a load bearing, non-load bearing or exterior wall. In some cases, walls may have to span heights greater than normal. For these cases, the stud size or gauge may be increased to reduce wall deflection. For exterior walls, the stud thickness is typically a minimum of 6” (152mm) depending on the thermal insulation requirements of the building envelope. These designs will exceed the IC Tech Spec-for ICD/ICS 705 required STC rating but should not require a waiver since the design exceeds the standard based on other criteria.

3-4.4.2 Gypsum Board.

IC Tech Spec-for ICD/ICS 705 indicates Standard STC 45 wall has three layers of 5/8 inch (15.9 mm) gypsum wallboard (GWB). One layer on the uncontrolled side (outside) of the protected area and two layers on the controlled side (interior) of the protected area to meet STC 45, see Figure 3-3. The STC 50 wall in IC Tech Spec-for ICD/ICS 705 indicates four layers. Two layers on the outside and two layers on the inside, see Figure 3-4.

- Stagger joints on the opposite sides of a partition so they are not on the same stud.
- Install the GWB so that the joints of the face layer are offset from the joints of the base layer.
- Joints in the face layer that are parallel to the framing members must fall over the framing members and offset from the base layer.

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[5] IC Tech Spec – for ICD/ICS 705

Exception: When using adhesive between the layers, joints in the face layer do not have to occur over the framing member

3-4.4.3 Factory-Laminated GWB.

To enhance the sound attenuation of the assembly, one layer of factory laminated GWB meeting ASTM C1766 may be used. GWB meeting ASTM C1766 is designed for sound control systems and is composed of two layers of gypsum panels factory-laminated into a composite panel.

Figure 3-3 STC 45 Assembly

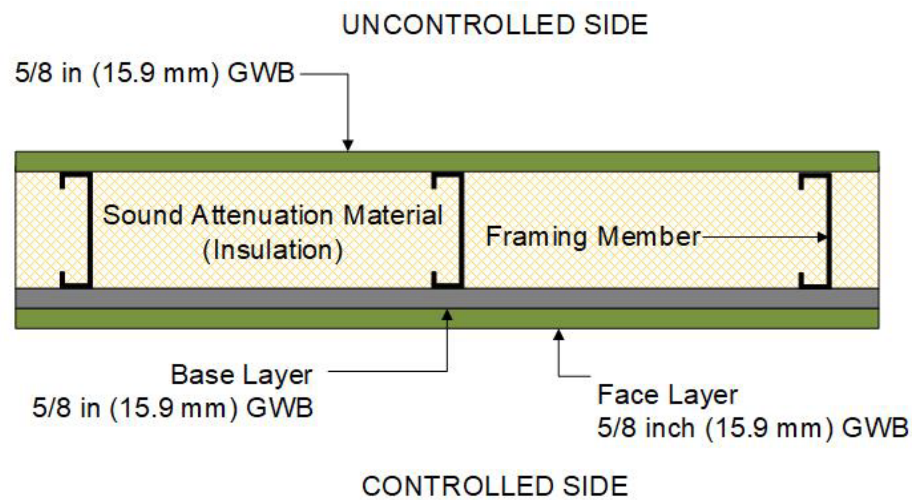
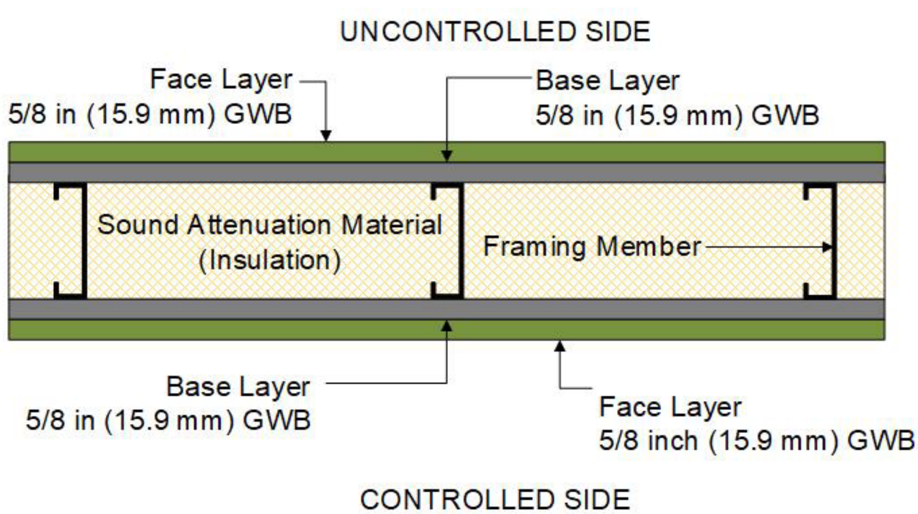


Figure 3-4 STC 50 Assembly



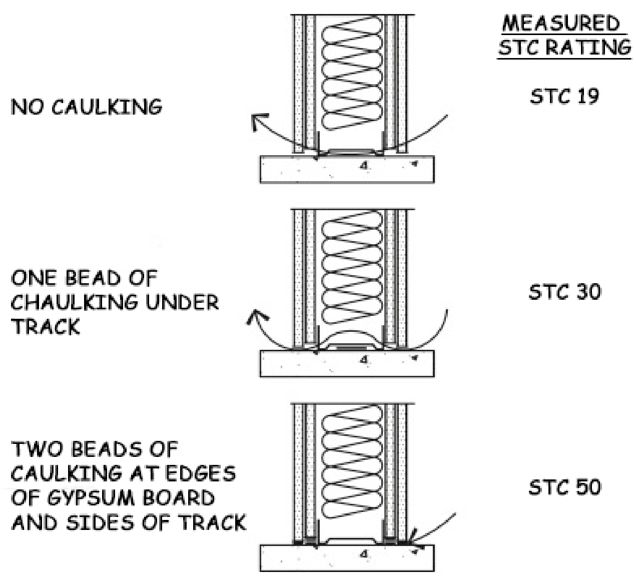
3-4.4.4 Insulation.

Use fibrous insulation to improve the sound isolating performance of the system. Over-packing the cavity may decrease the performance. In addition, the use of spray foam or other hardening insulations may decrease the sound performance.

3-4.4.5 Sealing Gaps.

Gypsum board panels are lifted into place during construction using a spacer under their bottom edge, so there is a 1/8 inch to 1/4 inch (3 mm to 6 mm) gap at the bottom. Sealing openings in partitions is critical to acoustical performance. Seal gaps on both sides with a non-hardening caulk so the acoustical rating of the wall is maintained. Figure 3-5 shows how sealing the gaps effect the STC ratings of the connection.

Figure 3-5 Sealing Tracks



3-4.4.6 Wall Finish.

Walls must be uniformly finished and painted from floor slab (true floor) to underside of floor or roof deck (true ceiling). See Figure 3-6.

3-4.4.7 Utilities on Perimeter Wall.

Utilities such as power, telecommunications, signal, and plumbing on the perimeter or compartmented wall treated for acoustic or RF must be surface mounted or construct a furred out wall for routing of utilities. This include recessed outlet boxes, recessed panels for power, telecommunications, ESS, fire alarm and other systems. Do not mount utilities in a manner that will affect the acoustic or RF shielding performance.

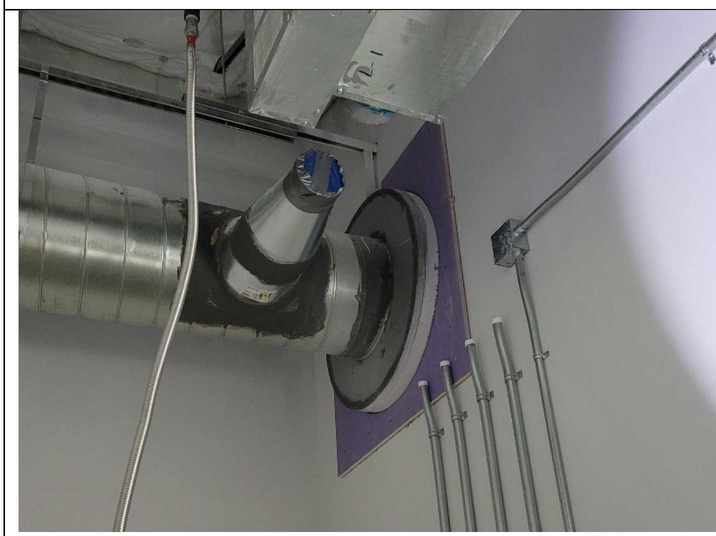
If a furred out wall is used, provide a minimum 3/8 inch (10 mm) gypsum board. The gypsum board only needs to go above the false ceiling. Figure 3-7 shows an example of a furred out wall prior to the installation of the 3/8 inch (10 mm) gypsum board.

Figure 3-6 Wall Finish

<table>
<tr><td></td><td>

UNACCEPTABLE

- Wall not uniformly finished and painted.
- Wall assembly does not meet acoustic rating
  - Wall not continuous and sealed where wall abuts floor pan.
- Wall penetrations not sealed.

</td></tr>
<tr><td></td><td>

UNACCEPTABLE

- Not uniformly finished and painted.
- Gap between finished and unfinished GWB
- Gap between unfinished GWB and duct penetration
- Not finished and painted and the penetrations are not sealed and finished.

</td></tr>
<tr><td></td><td>

ACCEPTABLE

- Wall is true floor to true ceiling
- Wall is sealed where wall abuts floor pan.
- Wall is uniformly finished and painted from true floor to true ceiling
- Wall penetrations are sealed.

</td></tr>
</table>

Figure 3-7 Furred Out Wall for Utilities

3-4.4.8 Recessed Fire Extinguisher Cabinets.

Recessed fire extinguisher cabinets are prohibited on perimeter or sound rated compartmented area walls.

3-4.5 Ceilings and Floors.

Ceilings and floors must meet the same requirements as walls with regard to forced entry, covert entry, visual evidence of surreptitious penetration, and sound attenuation. In addition, ceilings, floors and all penetrations must meet TEMPEST requirements when recommended by the TCR

3-4.6 Perimeter Doors.

Perimeter doors and frame assembles must meet acoustic requirements unless declared a non-discussion area and protected by IDS. Provide dead bolts for perimeter doors with day access controls for occupants. In addition, perimeter doors must meet TEMPEST requirements when recommended by the TCR. All perimeter doors must be solid with no lites or sidelites.

3-4.6.1 Acoustic Rated Doors.

Use UFGS 08 34 73 to specify acoustical rated door assemblies to include door, seals, hinges, door closer, frame and threshold. Provide door assemblies that are factory tested in accordance with ASTM E90 to no less than STC 50 when a STC 45 perimeter is required and no less than STC 55 when STC 50 perimeter is required. This will help ensure the door assemblies meet the minimum STC requirement when installed correctly.

Acoustical rated door assemblies are much heavier than typical doors and require heavy-duty hardware and structurally adequate support. For acoustics, utilize structural C or U channel in lieu of tubing. Coordinate design of structural support with a Structural Engineer and install in door assembly in accordance with UFGS 08 34 73 and manufacturer’s instructions.

3-4.6.2 Wood doors.

When used, wood doors must meet following minimum specifications:

- 1 ¾ inch (45 mm) thick solid wood core (wood stave, structural composite lumber).
- Lock area predrilled.

3-4.6.3 Steel Doors.

At a minimum, steel doors must meet following specifications:

- 1 ¾ inch (45 mm) thick face steel equal to 18 gauge.
- Lock area predrilled and reinforced to 10 gauge.

3-4.6.4 Door Closers.

Equip perimeter doors with a heavy-duty automatic non-hold door-closer installed internal to the perimeter the installation area reinforced to a minimum of 12 gauge for a steel door and at the top rail for a wood door.

3-4.6.5 Electric Locks.

Electric door strikes or electrified mortise locks installed with an access control system (ACS) must have a positive engagement, fail secure, and approved under UL 1034 for burglar resistance.

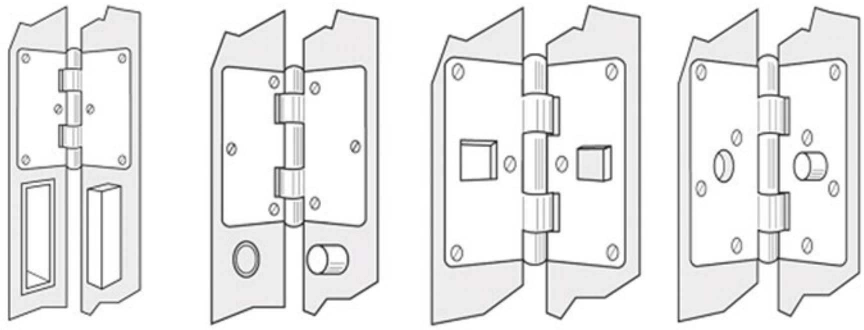
3-4.6.6 Hinges.

Hinges must be reinforced to a minimum of 7 gauge, and be cam-lift for acoustical door assemblies.

3-4.6.6.1 Hinge Pins.

Hinge pins on perimeter doors must be tamper resistant unless mounted on the protected side of the door. Tamper resistant hinges must have non-removable pins, security pins, set screws, welded, or equipped with a safety stud. See Figure 3-8.

Figure 3-8 Tamper Resistant Hinges



3-4.6.7 Primary Entrance.

Unless approved by the AO, provide one primary entrance where visitor control is conducted. Primary entrance must be:

- Equipped with an approved automated access control device.
- Equipped with a GSA-approved pedestrian door deadbolt meeting Federal Specification FF-L-2890.
- Equipped with combination lock meeting Federal Specification FF-L-2740.
- Equipped with a key override in the event of a malfunction or loss of power to the ACS.

3-4.6.8 Secondary Entrance.

In addition to the primary entrance, a secondary entrance may be allowed with AO approval. As with the primary entrance, the secondary entrance should incorporate a vestibule to preclude visual observation and enhance the acoustic protection. Secondary entrance must be:

- Equipped with an approved automated access control device.
- Equipped with a GSA-approved pedestrian door deadbolt meeting Federal Specification FF-L-2890. Additional standalone and flush mounted deadbolts are prohibited.

3-4.6.9 Primary and Secondary Entrance Vestibule.

When practical, the primary and secondary entrance should incorporate a vestibule to preclude visual observation and enhance acoustic protection. Primary entrance vestibule may have to accommodate space for visitor check-in and badging. In most applications, the interior door of the vestibule will be sound rated and the secure perimeter. To improve acoustic protection, provide acoustic treatments in vestibules to help absorb and diffuse sound.

3-4.6.10 Emergency Exit Doors.

Emergency exit doors must meet perimeter door requirements and:

- Have no exterior hardware; see Figure 3-9.
- Equipped with a GSA-approved pedestrian door deadbolt meeting Federal Specification FF-L-2890. Additional standalone flush-mounted deadbolts are prohibited.
- Alarmed 24/7 and equipped with a local annunciation.
- Delayed-egress is recommended with NFPA 101 compliance.

Figure 3-9 Emergency Exit Doors

3-4.6.11 Vault Doors.

General Services Administration (GSA)-approved Class 5 vault door equipped to meet Architectural Barriers Act (ABA) Standards. General Services Administration (GSA) has authorized the use of federal specification AA-D-600D for vault doors.

3-4.6.12 Roll-up Doors.

Roll-up doors can only be located in an area of non- discussion due to the inability to treat for acoustics. Roll-up doors must be 18 gauge or greater and secured with dead bolts on each side of the door.

3-4.6.13 Double Doors.

Double doors should not be used on the perimeter. If double doors are used:

- Secure one side with deadbolts at the top and bottom.
- Provide an astragal strip attached to either door to prevent observation into the space through the opening between the doors.
- Provide an independent high security switch (HSS) level 2 on each door.

3-4.7 Personal Electronic Device (PED) Cabinets.

Provide lockable metal cabinets outside the primary entrance for the storage of PEDs, see Figure 3-10. PED cabinets cannot be located within 10 ft. (3 m)[6] of equipment processing unencrypted NSI. Recessed PED cabinets are prohibited on perimeter walls.

Figure 3-10 PED Cabinets

3-4.8 Windows.

Every effort should be made to minimize windows, especially on the ground floor. When used, windows must be non-opening, be provide visual and acoustic protection and include TEMPEST requirements when recommended by the TCR.

3-4.8.1 Windows less than 18 feet (5.5 meters).

Windows less than 18 feet (5.5 meters) (measured from the bottom of the window) above the ground or from the nearest platform; such as lower roof, canopy or mechanical equipment, which affords access to the window must:

- Meet the standards of the perimeter
- Monitored by IDS

Large glazing panels may require noise generator transducers to achieve acoustic protection.

3-4.9 Daylighting.

Secure facilities are not exempt from the high performance building requirements of UFC 1-200-02. Promote access to daylight in breakrooms and other common spaces.

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[6] DoDM 5105.21-V2 and CNSSAM TEMPEST/1-13

When provided, daylighting design must be coordinated with the SSM. Design daylighting fenestration to be non-opening, provide visual and acoustic protection and include TEMPEST countermeasures when recommended by the TCR.

3-4.9.1 Daylighting Penetrations less than 18 feet (5.5 meters).

Daylighting penetrations that are less than 18 feet (5.5 meters) (measured from the bottom of the fenestration) above the ground or from the nearest platform; such as lower roof, canopy or mechanical equipment, which affords access to the fenestration or accessible from the roof must:

- Meet the standards of the perimeter
- Monitored by IDS

3-4.10 Visual Protection of Windows and Daylighting Fenestration.

Provide visual protection by methods such as full surface acid etching, sand blasting, or an obscure polyvinyl butyral interlayer. Method must obscure vision into the protected area while providing light transmission. Specify a maximum of 75% diffuse transmittance and a minimum haze of 90% when tested in accordance with ASTM D1003.

For existing windows, blinds, drapes or other coverings may be used with SSM/SSO approval.

3-4.11 Perimeter Penetrations.

Keep penetrations of the perimeter to a minimum. Ducts, conduits, pipes, or anything that penetrates the perimeter presents a vulnerability that must be addressed. All penetration must meet the acoustic requirements of the perimeter. In addition, perimeter penetrations may require TEMPEST countermeasures when recommended by TEMPEST Countermeasure Review.

Ducts, conduits or pipes servicing other areas cannot penetrate the perimeter unless mitigated with AO approval.

3-4.11.1 Utility Penetrations.

Utilities (power and signal) should enter at a single point. Seal all utility penetrations to mitigate acoustic emanations and covert entry. Spare conduits are allowed for future expansion provided the expansion conduit is filled with acoustic fill and capped or a Fire Stop System may be required for fire rated assemblies.

3-4.11.2 Metallic Penetrations.

All metallic penetrations through the perimeter are considered carriers of compromising emanations (CE) and pose TEMPEST hazards that must be addressed. Unless directed otherwise by the TEMPEST Countermeasure Review:

- Metal conduit or pipe: provide a nonconductive union inside the perimeter adjacent to the penetration, or ground the conduit within 6 inch (150 mm) of the perimeter penetration using a no. 4 wire (0.2043-diameter copper wire) to the building grounding system.
- Metallic sprinkler (fire suppression) pipe: ground the pipe within 6 inch (150 mm) of the perimeter penetration using a no. 4 wire (0.2043-diameter copper wire) to the building grounding system.
- Mechanical system refrigerant lines: ground the line within 6 inch (150 mm) of the perimeter penetration using a no. 4 wire (0.2043-diameter copper wire) to the building grounding system. Maintain integrity of refrigerant line insulation.
- HVAC ducts: provide a nonconductive break (flex connection) using material appropriate for the climate, for a 2- to 6-inch (50 to 150 mm) section of the duct inside the perimeter adjacent to the penetration, see Figure 3-11. When a waveguide is recommended by TEMPEST Countermeasure Review, provide between the perimeter and the nonconductive break.

In addition, the TEMPEST Countermeasure Review may require additional countermeasures.

Figure 3-11 Duct Penetrations

3-4.11.3 Penetration Seals.

Seal both sides of perimeter penetrations with an acoustical foam or sealant finished to match adjacent wall, floor, or ceiling see Figure 3-12. Fire Stop System may be required for fire rated assemblies. In addition, penetration seals must meet TEMPEST requirements when recommended by the TEMPEST Countermeasure Review.

Figure 3-12 Sealing Penetrations

3-4.12 Vents and Ducts.

Protect all vents or duct openings exceeding 96 square inches (619 cm2) that penetrate the perimeter with permanently affixed bars, grills, diamond mesh, welded wire fabric, metal sound baffles or waveguides. If one dimension of the penetration measures less than 6 inch (150 mm), protection is not required. One of the following can be used to secure openings 6-inches (150 mm) or more in any dimension.

- A minimum of ½ inch (13 mm) diameter steel bars welded vertically and horizontally 6 inch (150 mm) on center. A deviation of ½ inch (13 mm) in vertical and/or horizontal spacing is permissible, see Figure 3-13.
- ¾ inch (20 mm) #9 (10 gauge) case hardened expanded metal grills.
- Carbon steel standard expanded metal diamond mesh, 1-1/2” (38 mm) #10 (13 gauge). With a maximum design size of 1-3/8” by 3” (35 mm x 76 mm), strand size thickness of 0.093” (2.36 mm), with at least 80% open design).
- Welded wire fabric (WWF) 4x4-W2.9xW2.9 (6 gauge) smooth steel wire welded vertically and horizontally four inches on center.
- Metal sound baffles or waveguide permanently installed and set no farther apart than 6 inch (150 mm) in one dimension.

Coordinate material selection with Mechanical Engineer to ensure proper airflow and fan sizing.

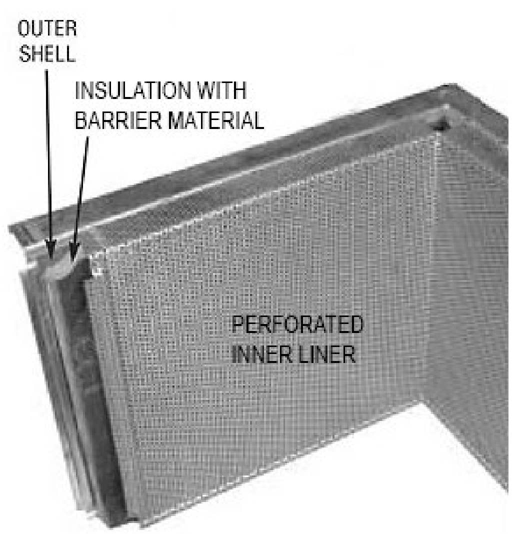
Figure 3-13 Bars on Penetration

3-4.13 Acoustic Protection for Ducts.

To ensure acoustic performance of the perimeter is not compromised, provide sound baffles (duct silencers) or (Z) Duct Penetrations. IC Tech Spec – for ICD/ICS 705 provides an example of a (Z) Duct Penetration. Coordinate selection with the mechanical engineer. Backpressures created by the baffles may significantly impact the HVAC system design.

Be aware, (Z) Duct Penetration in IC Tech Spec – for ICD/ICS 705 indicates acoustically lined duct. Per UFC 3-410-01, acoustical duct liner is not allowed. In lieu of acoustical duct liner, provide double wall acoustic duct, see Figure 3-14. For contamination protection, include a barrier material between the perforated liner and the insulation designed to prevent air quality issues caused by bacteria and other contaminates that can embed in the insulation.

Figure 3-14 Double Wall Acoustic Duct

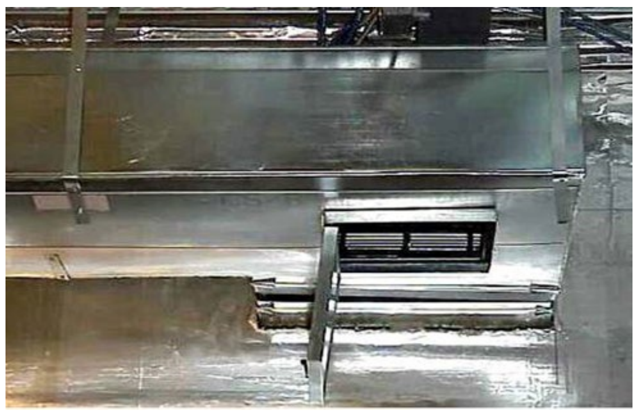


3-4.14 Access Port.

For vents or ducts that require bars or grill, provide an accessible access panel in the bottom within the perimeter to allow visual inspection of the bars, grill, or waveguide, see Figure 3-15.

If the area outside the perimeter is controlled (SECRET or equivalent proprietary space), the inspection port may be installed outside the perimeter, and be secured with an AO approved high-security lock such as a GSA combination padlock meeting Federal Specification FF-P-110.

Figure 3-15 Access Port



3-4.15 Flashing or Rotating Light.

Per DoDM 5105.21 Vol 2 and DoDM 5205.07 Vol 2, personnel must be informed when non-indoctrinated personnel have entered and departed the space. Per IC Tech Spec, Lights, signs, or other alerting mechanisms or procedures must be used to alert occupants of the presence of uncleared personnel. This may be accomplished either verbally or through visual notification methods. A flashing or rotating light is an approved method to indicate the presence of non-indoctrinated personnel in the area. This can be hand held or installed.

Coordinate use of flashing or rotating notification lights with mission requirements. There may be light-sensitive or simulation equipment that preclude use of such light during ongoing operations. When installed, place lights to ensure visual observation by the occupants of the space. At a minimum, provide controls within the perimeter at each entrance into the space or compartmented area.

3-4.16 Duress Alarm.

When a duress alarm is required, duress alarm must initiate an alarm condition at the central monitoring station and no audible or visual signal in the protected area.

3-4.17 Electronic Security System (ESS).

An ESS is comprised of three primary subsystems; intrusion detection system (IDS), access control system (ACS), and video system along with a supporting data transmission network and electrical power system.

ESS systems must meet the requirements of ICS 705-1 and IC Tech Spec-for ICD/ICS 705 and be designed in accordance with UFC 4-021-02. UFC 4-021-02 provides notional layouts for typical ESS systems.

3-4.17.1 Access Control System (ACS).

At a minimum, provide card reader with keypad at the primary entrance and when provided, the secondary entrance. Unless otherwise directed, the default ACS identifier credential is the Common Access Card (CAC)[7].

- Locate equipment containing access-control software programs within the perimeter or a SECRET controlled area.
- Protect system data that is carried on transmission lines (e.g., access authorizations, personal identification, or verification data) to and from equipment located outside the perimeter using FIPS AES certified encrypted lines. If this communication technology is not feasible, provide transmission lines as approved by the AO.
- Provide electric locks with positive engagement, fail secure, and approved under UL 1034 for burglar resistance.

3-4.17.2 Video System.

Cameras are not allowed within the perimeter or enable observation within the perimeter. A camera may be provided on the exterior to supplement the monitoring of a primary entrance for remote control of the door from within the space. A Video Intercom System may provide this capability. The system must provide a clear view of the primary entrance that is monitored and operated by indoctrinated personnel.

3-4.17.3 Intrusion Detection System (IDS).

Protect the space with IDS when not occupied. Protect all Interior areas through which reasonable access to the asset could be gained with IDS.

- The IDS must be independent of systems safeguarding other facilities and compatible with Installation's central monitoring system.
- Provide point sensors on perimeter doors and man-passable openings such as roof hatches.
- Provide motion sensors within the perimeter to protect perimeter windows, doors, daylight fenestrations, and man-passable openings.

[7] Per DoD 5200.08-R

- Strategically place motion sensors within the space to detect movement where assets are stored or where assets are stored or in pathways leading to the asset. One hundred percent coverage is not required.
- Motion sensors are not normally required above false ceilings or below false floors; however, these detectors may be required by the AO for critical and high threat facilities outside the U.S.
- Monitor emergency exit doors 24 hours a day. Provide local annunciation to alert occupants when the door opened with identification of the appropriate door when there is an alarm indication.

3-4.17.3.1 Intrusion Detection Installation and Components.

Per IC Tech Spec – for ICD/ICS 705, IDS installation, related components, and monitoring stations must comply with Underwriters Laboratories (UL) 2050 Extent 3 standards. Systems developed and used exclusively by the U.S. Government do not require UL certification but must comply with UL 2050 Extent 3 standards for installation. UL 2050 materials are restricted and only distributed to those demonstrating relevant national industrial security involvement. However, UL 2050 implements UL 681, Installation and Classification of Burglar and Holdup Alarm Systems for alarm system installation. See UFC 4-021-02 for additional information and a notional ESS layout.

3-4.17.3.2 Motion Detection Sensors.

UL 639 Listed. Dual-technology sensors may be used when authorized and when each technology transmits alarm conditions independent of the other technology ("or" configuration).

3-4.17.3.3 Point Sensors.

UL 634 HSS level 2. Level 2 rated switches only include Balanced Magnetic Switches that pass additional performance testing.

3-4.17.3.4 Sensor Cabling.

Cabling between sensors and the PCU must be dedicated to the system, contained within the perimeter, and comply with Committee for National Security Systems (CNSS) standards. If the wiring cannot be contained within the perimeter, meet the requirements for External Transmission Line Security.

3-4.17.3.5 Premise Control Unit (PCU).

Locate PCU within the Perimeter. Configure system to only allow cleared personnel located within the secure/protected area to initiate changes in access modes or alarm conditions.

PCUs certified under UL 1610 must meet FIPS 197 or FIPS 140-2 encryption certification and methods. For PCUs certified under UL1076, only FIPS 140-2 is the acceptable encryption certification and method.

3-4.17.3.6 External Transmission Line Security.

IDS transmission lines to the central monitoring station, must meet National Institute of Standards and Technology, Federal Information Processing Standards (FIPS) certified encrypted lines.

All lines employing line supervision require certification of the algorithm by the National Institute of Standards and Technology (NIST) (a NIST certificate). An alternate form of line supervision may be approved on a case-by-case basis.

3-4.17.3.7 Standby Power.

Provide twenty-four hours of uninterruptible standby power. This may be provided by batteries, uninterruptible power supply (UPS), or engine-generators, or any combination. Standby power for IDS should not generate the requirement for a UPS or engine-generator. When an engine-generator is available for standby power, provide batteries for IDS that provide a minimum of four hours of standby power to allow uninterrupted power during transitions to and from standby generator power.

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

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

3-4.17.3.8 IDS Approval.

The AO must approve IDS proposals and plans prior to installation as part of the pre-construction approval process.

3-4.18 Telecommunications Space.

Per UFC 3-580-01, the minimum size for Telecommunications Room (TR) is 10 feet x 8 feet (3m x 2.4m). This will be inadequate if the telecommunications space contains equipment racks for multiple networks such as Secret Internet Protocol Router Network (SIPRNet), Joint Worldwide Intelligence Communications System (JWICS), Non-classified Internet Protocol Router Network (NIPRNet), voice services, and other equipment or services. Depending on the number of workstations served, this could generate a larger space requirement when considering the equipment racks and RED/BLACK separation requirements.

UFC 3-580-01 allows the use of an Equipment Room in lieu of a TR for buildings that house substantial Information Technology (IT) electronics. A telecommunication space that contains equipment for multiple networks such as SIPRNet, JWICS and NIPRNet all requiring RED/BLACK separation is considered as substantial Information Technology (IT) electronics which would allow for the use of a larger Equipment Room.

3-4.18.1 Telecommunications Expansion.

Design the telecommunication spaces to accommodate future equipment expansion. At a minimum, UFC 3-580-01 requires one spare rack for every four utilized racks with the minimum of one spare rack. Future operational capability for these types of facilities may require additional expansion space. Coordinate future expansion capabilities with mission commander and the C5ISR equipment provider. Provide additional power, environmental support, and floor space for the future expansion.

3-4.18.2 Temperature and Humidity Control.

Substantial Information Technology (IT) equipment generate a significant amount of heat. In these environments, the heat densities can be up to five times higher than in a typical office load. Traditional HVAC systems cannot remove enough heat to protect IT equipment. Instead, these areas require systems with higher cooling capabilities such as a computer room air conditioner (CRAC). The smallest high-powered CRACs require a minimum 10 ft. x 3 ft. (3m×1m) footprint for equipment and clearances.

Design air-conditioning systems for year-round cooling with very high cooling intensity. The high sensitivity of electronic components in such facilities requires that temperature, humidity, air movement and air cleanliness must be kept consistent and within specific limits to prevent premature equipment failures and costly downtime.

3-4.19 Telecommunication Cabling System.

Cabling, patch panels, connector blocks, work area outlets, and cable connectors must be color coded[8] to distinguish their classification level. If color-coding is not possible, cabling must be clearly marked to indicate their classification level. Cabling must enter the protected area from a single location and must be identified and labeled with its purpose and destination at the point of entry. Backbone and horizontal cabling may differ depending on network classification, service provider, and TEMPEST requirements. Coordinate requirements with SSM and service provider. See TEMPEST Countermeasures.

3-4.20 Protected Distribution Systems (PDS).

Protect signal distribution systems containing unencrypted NSI that enters an area of lesser classification, unclassified area, or uncontrolled (public) area with a PDS in accordance with CNSSI No 7003.

[8] Per DoDM 5105.21 Vol 1

Avoid the use of PDS whenever possible due to inspection requirements. To avoid PDS, keep cabling transmitting unencrypted NSI within the protected perimeter.

3-4.21 RESILIENCE.

Some facilities must continue to operate effectively or recover rapidly to support the mission in the event of severe weather, earthquake, loss of utility, or equipment failure. Defining the appropriate International Building Code (IBC) Risk Category is critical in determining the earthquake, flood, snow and wind load requirements that will apply to the building. Some critical operations or C5ISR systems require redundant utilities, standby power systems, and redundant support systems to ensure continuous operation in the event of utility or equipment failure.

Coordinate resiliency requirements with the mission commander.

3-4.21.1 Redundant Utilities.

Critical operations or C5ISR systems may require redundant utilities such as telecommunication system connectivity or utility power service. To be redundant, the utilities providing connectivity or power to the facility must be two separate utilities that are not routed together.

3-4.21.2 Standby Power System (SPS).

Critical operations or C5ISR systems may require an SPS designed to ensure continuity of electrical power to essential and uninterruptible loads upon loss of normal power sources. Design SPS in accordance with NFPA 70 and NFPA 110. The SPS must have the capacity and rating to meet the maximum demand likely to be produced by the essential and uninterruptible loads and be consistent with the facilities emergency operations plan.

3-4.21.2.1 Engine-Driven Generator.

When a SPS is required, provide a standby engine-driven generator for essential and uninterruptible loads to ensure continued operation upon loss of utility power. Design the standby generator in accordance with UFC 3-540-01.

3-4.21.2.2 UPS Systems.

When a SPS is required, provide UPS for the uninterruptible loads to filter commercial power and to support the uninterruptible loads during transitions to and from the standby generator.

3-4.21.3 Redundant Support Systems.

Some critical operations may require support systems with a minimum of N+1 redundancy to ensure continuous operation in the event of component failure. In this configuration, components (N) have at least one independent backup component (+1). For a critical communication system, the N+1 redundancy would be applied to support systems such as the air-conditioning systems and SPS required to support continuous operation. For example, if the essential and uninterruptible loads required two 250 kW generators, N+1 would result in three 250 kW generators.

3-4.22 TEMPEST.

TEMPEST is a short name referring to investigation, study and control of compromising emanations from telecommunications and automated information systems equipment. In general, TEMPEST countermeasures apply when there is equipment that will be processing national security information (NSI). The intent is to minimize the likelihood that these emanations will be intercepted.

3-4.22.1 TEMPEST Countermeasures Review (TCR).

Each project requires a TEMPEST countermeasures review (TCR), performed or verified by the Certified TEMPEST Technical Authority (CTTA). The SSO or SSM will request a TCR by submitting a TEMPEST addendum to the FFC. For an initial TCR, the TEMPEST addendum will be submitted to AO during the preliminary design phase. While some specific information may not be known prior to construction, as much information as possible must be provided in order to minimize costly changes. Based on the results of the TCR, the CTTA will determine the most cost-effective countermeasures and will document these requirements in writing[9].

3-4.22.2 TEMPEST Countermeasures.

TEMPEST-suppressed equipment, radio frequency (RF) shielded enclosures, filters (power, signal, telephone, etc.), nonconductive conduit or duct sections, or other potentially expensive TEMPEST countermeasures must not be applied without AO approval. Normally, facilities located on military installations within the United States do not require additional countermeasures beyond implementing RED/BLACK separation guidance depending on threat and mission requirements. However, facilities that are located outside the U.S., off a military installation, in close proximity with a foreign entity; or facilities that share a common wall, floor, or ceiling with a non-government element may require additional measures beyond implementing RED/BLACK separation[9]. These additional measures are determined through the TCR process and approved by the AO.

3-4.22.3 RED/BLACK Telecommunication Systems.

All equipment, wirelines, components, and systems that process National Security Information (NSI) are considered RED. Equipment, wirelines, components, and systems that process encrypted NSI and non-NSI are considered BLACK. BLACK lines and other electrically conductive materials that egress the inspectable space are potential carriers of Compromising Emanations (CE) that can inadvertently couple to the RED lines. Various signal line isolation techniques such as separation and filtering are

[9] DoDM 5105.21 Vol 2 and DoDM 5205.07 Vol 3

used to protect the signal line, the distribution system or other fortuitous conductors from conducting compromising signals beyond secure areas.

Apply fundamental RED/BLACK mitigations in accordance with CNSSAM TEMPEST/01-13 to prevent the inadvertent transmission of classified data over telephone lines, power lines, signal lines, and electrical components, circuits, and communication media. The application of RED/BLACK separation establishes areas where equipment processing classified information (RED) are isolated from areas where equipment processing unclassified (BLACK) are located.

3-4.22.4 Radio Frequency (RF) Mitigation.

As documented in the TCR, protect the space from compromising emanations. When directed, provide RF mitigation for perimeter walls, ceilings, floors, doors, windows, skylights and penetrations with RF shielding, non-conductive breaks, and grounding. RF mitigations for penetrations may include waveguides.

When required, place foil layer on the secure side of the perimeter wall between the first and second layer of gypsum board. When required, place RF shielding material on floor and ceiling. Doors must be steel with RF gasket, and door frame must be electrically bonded continuously to RF shield. Entire window or skylight assembly must be RF shielded and widow or skylight frame and must be electrically bonded continuously to RF shield. Shielding must be electrically bonded continuously, with no gaps or discontinuities at any point, at interfaces between, walls, floors, ceilings, doors, windows, and skylights and penetrations. Power and low voltage systems may include power line and telecommunication line filters. Refer to *Best Practices Guidelines for Architectural Radio Frequency Shielding* for standard construction for RF shielding.

- Do not connect mounting apparatus to the RF shielding material in a manner that affects RF shielding performance.
- Consider providing furred out walls to protect RF shielding from future compromise.

3-4.22.5 RF Door ABA Compliance.

RF doors that utilize a knife-edge may not meet ABA Standards without modification due to accessibility requirements at the sill, see Figure 3-16. The use of temporary ramps will not meet ABA Standards.

3-4.22.6 Paging, Intercom, and Public Address Systems.

Systems should be totally contained within the perimeter. Refer to the TCR to determine TEMPEST countermeasures. Possible countermeasures may include:

- Separation of equipment and signal lines from RED telecommunication lines and processors.
- Provide a local buffer amplifier to prevent speakers or earphones from functioning as microphone. For most systems, this is a simple amplifier

within the perimeter that takes the incoming audio signal and amplifies/distributes the signal to the speakers within the perimeter.

- Provide electronic isolation for systems that require two-way communication. The system must alert occupants when the system is activated.
- Provide voice frequency, bandpass filters if they are not totally contained within the inspectable space. This protects against TEMPEST signals on the cables but does not protect against voice modulation of the speakers.
- Provide a subpanel within the perimeter with optical fiber backbone to the building system or convert the electrical signal to an optical signal before penetration of the perimeter. Provide optical fiber with no metallic shielding, cladding, or strength members.
- When required, provide electronic isolation components within the perimeter as near to the point of penetration as possible.

Figure 3-16 ABA Non-Compliant RF Door

3-4.22.7 Fire Alarm and Mass Notification System (MNS).

The introduction of electronic systems that have components outside the perimeter should be avoided. TEMPEST concerns may require electronic isolation. Speakers or other transducers, which are part of a system that is not wholly contained within the perimeter, may require mitigation. Refer to the TCR to determine TEMPEST countermeasures. Possible countermeasures may include:

- Separation of equipment and signal lines from RED telecommunication lines and processors.
- For eavesdropping (using the speakers as microphones), a simple buffer amplifier is the standard mitigation. For most systems, this is a simple amplifier within the perimeter that takes the incoming audio signal and amplifies/distributes the signal to the speakers within the space. However, equipment such as pre-amplifiers, amplifiers and products translating or converting live voice signals for use in mass notification systems must comply with the applicable requirements in UL 864, the Standard for Amplifiers for Fire-Protective Signaling Systems. Therefore, any amplifier used in a MNS must meet UL 864.
- Provide a MNS/Fire alarm subpanel within the perimeter with optical fiber backbone to the building system or convert the electrical signal to an optical signal before penetration of the perimeter. Provide optical fiber with no metallic shielding, cladding, or strength members.
- Provide electronic isolation for systems that require two-way communication. The system must alert the occupants when the system is activated.
- When required, provide electronic isolation components within the perimeter as near to the point of penetration as possible.

3-4.22.8 Power Systems.

The power requirements are divided into two groups -- power for the mission equipment (technical) and power for the supporting services (nontechnical). Supporting services include lighting, heating, ventilating, air conditioning, etc. Provide a separate service feeder dedicated to the sensitive equipment and control its distribution reducing the opportunity for unauthorized detection of compromising signals on those lines. Power line conduction occurs when data is transferred onto the power line by RED equipment, or radiated through free space and coupled onto the power lines. If a facility is processing NSI, power is sometimes divided into RED and BLACK power. RED power provides isolation for those non-TEMPEST approved equipment processing NSI. BLACK power is provided for equipment processing non-NSI because power isolation is not required. This separation prevents conducted emissions from RED equipment being coupled through BLACK equipment to BLACK lines that might egress the inspectable space. Refer to the TCR to determine TEMPEST countermeasures. Possible countermeasures may include:

- Separation of BLACK power lines from RED telecommunication lines and processors.
- Power line Filters. UPS within the perimeter may eliminate power line filters.

3-4.22.9 RF Communications Systems.

Facilities that require large RF communications systems (combat net radios, microwave systems, air to ground, or ship to shore) should be designed to place RF communications systems as far away from RED processors as possible.[10]

[10] DoDM 5105.21 Vol 2

CHAPTER 4 CONSTRUCTION

4-1 CONSTRUCTION AWARD.

Per IC Tech Spec – for ICD/ICS 705, prior to awarding a construction contract, a CSP for each project must be approved by the AO. The CSP documents the security requirements for the project. For Navy and Marine Corps projects, refer to NAVFAC INST 4700.01 for additional information.

4-2 CONSTRUCTION PLANS SECURITY.

Per ICS 705-1, protect and handle construction plans and related documents in accordance with the CSP. If classification guides dictate, plans and related documents may require classification. Under no circumstances should plans, diagrams, etc. that are identified for a SCIF or SAPF be sent or posted on unprotected information technology systems, networks or Internet venue without encryption.

4-3 CONSTRUCTION SITE SECURITY.

The SSM is the single point of contact regarding security and the individual responsible for the security aspects of the construction. The SSM will have 24-hour unrestricted access to the site to conduct periodic security inspections for the duration of the project. DoDM 5105.21 Vol 2 defines the minimum security requirements for the SCIF construction site. DoDM 5205.07 does not identify minimum security requirements for the SAPF construction site.

Refer to the CSP for the project specific security requirements.

4-4 ACCREDITATION PROCESS.

In support of the accreditation process and the updating of the FFC, and other required documentation, Project/Construction mangers will provide the SSM site plans, building floorplans, IDS plans, and information related to the perimeter's construction, penetrations, doors, locks, deadbolts, IDS, telecommunication systems, acoustical protection, low voltage systems, electrical power systems, and TEMPEST countermeasures. For SCIFs, refer to DoDM 5105.21 Vol 2, and for SAPFs, refer to DoDM 5205.07 Vol 3.

4-5 INSPECTIONS.

Coordinate preliminary walkthrough with the SSM prior to substantial completion of the space. SSM conducts periodic inspections of the area to validate and document elements for accreditation. Inspection elements may include:

- Perimeter construction
  - Wall goes from floor slab (true floor) to underside of floor or roof deck (true ceiling)
  - Wall uniformly finished and painted from true floor to true ceiling

- Top and bottom of walls are sealed (both sides) with acoustical foam or sealant
- Acoustic insulation is securely fastened
- Gypsum Wallboard installation
- Floor and Ceiling construction

- Perimeter Penetrations
  - Sealed (both sides) with acoustical foam or sealant
  - Finished to match wall
- Perimeter Doors
  - Door assemblies sealed with acoustical foam or sealant (both sides) and finished to match wall
  - Door hardware (locks, closers, sweeps and hinges)
  - ASTM E90 laboratory Test Report
  - ASTM E336 field Test Report
- HVAC Systems
  - Man-bar installation
  - Inspection Ports
  - Nonconductive break
  - Acoustic mitigation
    - Z-duct installation or sound baffle installation
- ESS installation
- TEMPEST Countermeasures (as applicable)
  - RED/BLACK LAN separation
  - Metallic penetrations at perimeter (non-conductive break or grounded at the interior perimeter
  - RF shielding including penetrations
  - Waveguides
  - Doors including RF gaskets
  - Power Line Filters
  - Signal Line Isolators and Filters

4-6 CONSTRUCTION DRAWINGS AND SUBMITTALS.

Prior to walk through; assemble required documents in support of the accreditation process. Requirements vary depending on project but in general assemble the following documents:

- Drawings:
  - Civil Site Plan
  - Architectural
    - Floor and Reflective Ceiling Plans
    - Perimeter wall sections (floor to ceiling)
    - Floor and Ceiling section
    - Door Schedule
    - Perimeter Door head, jamb, and threshold details
    - Window schedule and details
  - Fire Protection
    - Sprinkler piping grounding and penetration details
    - Low voltage cabling penetrations
    - Fire Alarm system
    - Mass Notification System
  - Mechanical
    - HVAC plans, sections and details of perimeter penetrations, ductwork details sheets
    - Plumbing floor plans, detail for perimeter penetrations
  - Electrical
    - Site plan
    - Lighting, Power, Telecommunications, Grounding, and ESS plans. Plans must indicate device and panel locations and when provided, include strobe lights and controls
    - One-line diagrams for Power, Telecommunications including RED/BLACK separation, and ESS
    - ESS door wiring details
    - Perimeter penetration details
- Submittals
  - Doors
  - Door Hardware (locks, closers, and hinges)
  - Acoustical rated assemblies
    - ASTM E90 Test Reports
  - Electronic Security Systems
  - TEMPEST Countermeasures (as applicable)

        - Non-metallic breaks
        - RF shielding
        - RF sealant
        - Waveguides
        - RF Shielded Doors including RF gaskets
        - RF Shielded Windows
        - Power Line Filters
        - Signal Line Isolators and Filters
    - RF Shielding Test Reports (as applicable)
- As-Built drawings

4-7 PHOTOGRAPHIC CONSTRUCTION SURVEILLANCE RECORD.

Photographic Construction Surveillance Record may be accomplished by the SSM or approved personnel to expedite the accreditation process. It is important to capture areas which will be covered up during construction. Pictures should capture:

- Wall construction
    - Stud walls
    - Acoustic insulation
    - Enhanced wall layer (when applicable)
    - Initial GWB layer installation
    - RF shielding installation
    - Wall penetrations
    - Wall finishes (true floor to true ceiling)
- Duct construction including inspection ports, Z-Ducts, Sound baffles and man-bars.

APPENDIX A MINIMUM CONSTRUCTION

A-1 MINIMUM CONSTRUCTION.

Table A-1 is provided as a synopsis of the construction and alarm requirements based on the IC Tech Spec-for ICD/ICS 705. Construction is determined on a project-by-project basis by the Commander or their designated SSM working with the AO.

Table A-1 Minimum Construction and Alarm

	CLASSIFICATION	TYPE OF CONSTRUCTION[1]	IDS[3]	ACS[4]	DURESS
INSIDE UNITED STATES, ITS POSSESSIONS OR TERRITORIES	Open Storage without SID[5]	Wall B - Enhanced Wall (Expanded Metal)[2] Wall C - Enhanced Wall (Plywood)[2]	YES	YES	NO
	Open Storage with SID[5]	Wall A - Standard Wall[2]	YES	YES	NO
	Closed Storage	Wall A - Standard Wall[2]	YES	YES	NO
	Continuous Operations	Wall A - Standard Wall[2]	YES	YES	NO
	Secure Working Area (SWA)	Wall A - Standard Wall[2]	YES	YES	NO
OUTSIDE UNITED STATES, ITS POSSESSIONS OR TERRITORIES	SETL Cat I[6]				
	Open Storage	Vault [2]	YES	YES	RECOMMENDED
	Closed Storage	Wall B - Enhanced Wall (Expanded Metal)[2] Wall C - Enhanced Wall (Plywood)[2]	YES	YES	NO
	Continuous Operation	Wall B - Enhanced Wall (expanded Metal)[2] Wall C - Enhanced Wall (Plywood)[2]	YES	YES	YES
	SETL Cat II & III[6]				
	Open Storage	Wall B - Enhanced Wall (expanded Metal)[2] Wall C - Enhanced Wall (Plywood)[2]	YES	YES	RECOMMENDED
	Closed Storage	Wall B - Enhanced Wall (Expanded Metal)[2] Wall C - Enhanced Wall (Plywood)[2]	YES	YES	NO
	Continuous Operation	Wall A - Standard Wall[2]	YES	YES	RECOMMENDED
	Secure Working Area (SWA)	Wall A - Standard Wall[2]	YES	YES	RECOMMENDED

Notes:

1. Table indicates the minimum construction from IC Tech Spec-for ICD/ICS 705.
2. Refer to IC Tech Spec-for ICD/ICS 705 for construction definitions and suggested details. Include Radio Frequency (shielding) protection, enhanced construction and sound attenuation as required.
3. IDS - Intrusion Detection System
4. ACS - Access Control System at Primary and secondary (if provided) entrance.
5. SID - Security in Depth
6. Security Environment Threat List (SETL). SETL Categories are classified.

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APPENDIX B GLOSSARY

B-1 ACRONYMS.

ACS	Access Control System
AO	Accrediting Official
BIA	Bilateral Infrastructure Agreements
C5ISR	Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance
CA	Compartmented Area
CSA	Cognizant Security Authority
CSP	Construction Security Plan
CTTA	Certified TEMPEST Technical Authority
DNI	Director of National Intelligence
ER	Equipment Room
ESS	Electronic Security System
FFC	Fixed Facility Checklist
HNFA	Host Nation Funded Construction Agreements
HSS	High Security Switch
IC	Intelligence Community
IDS	Intrusion Detection System
JWICS	Joint Worldwide Intelligence Communications System
MNS	Mass Notification System
NIPRNET	Non-classified Internet Protocol Router Network
NSI	National Security Information
PDS	Protected Distribution System
PCU	Premise Control Unit
RF	Radio frequency

SAO Special Access Program Facility Accrediting Official

SAP Special Access Program

SAPF Special Access Program Facility

SCI Sensitive Compartmented Information

SCIF Sensitive Compartmented Information Facilities

SETL Security Environment Threat List

SID Security-in-depth

SIO Senior intelligence Official

SIPRNET Secret Internet Protocol Router Network

SOFA Status of Forces Agreements

SPS Standby Power System

SSM Site Security Manager

SSO Special Security Officer

STC Sound Transmission Class

SWA Secure Working Area

TCR TEMPEST Countermeasure Review

TR Telecommunications Room

TSWA Temporary Secure Working Areas

UFGS Unified Facilities Guide Specification

VTC Video teleconference

B-2 DEFINITION OF TERMS.

Accrediting Official (AO): Person designated by the Cognizant Security Authority (CSA) that is responsible for all aspects of SCIF management and operations to include security policy implementation and oversight.

BLACK Equipment: A term applied to equipment that processes only unclassified and/or encrypted information. (CNSSAM TEMPEST/1-13)

BLACK LAN: A term applied to equipment, cables, or fiber that processes or carries only unclassified and/or encrypted information. (CNSSAM TEMPEST/1-13)

Certified TEMPEST Technical Authority (CTTA): U.S. Government employee who has met established certification requirements in accordance with NSTISSC-approved criteria and has been appointed by a U.S. Government department or agency.

Classification Guide: A documentary form of classification guidance issued by an Original Classification Authority (OCA) that identifies the elements of information regarding a specific subject that must be classified and establishes the level and duration of classification for each such element. (ODNI 80.16)

Cleared American Guard: A U.S. Secret cleared guard that performs access control functions to screen all non-cleared workers, vehicles, and equipment entering or exiting the site and conducts random inspections of site areas. (IC Tech Spec – for ICD/ICS 705)

Closed Storage: The storage of sensitive material in properly secured GSA approved security containers within an accredited space.

Cognizant Security Authority (CSA): The single Principal designated to serve as the responsible official for all aspects of security program management with respect to the protection of intelligence sources and methods.

Compartmented Area (CA): An area, room, or a set of rooms within the accredited space that provides controlled separation between control systems, compartments, sub-compartments, or Controlled Access Programs. (IC Tech Spec – for ICD/ICS 705)

DoD Construction Agent. The U.S. Army Corps of Engineers, the Naval Facilities Engineering Systems Command, or such other approved DoD activity assigned the design or construction execution responsibilities associated with the military construction program. (DoDD 4270.5)

Construction Security Plan (CSP): The plan developed by the SSM and approved by the AO, which outlines security protective measures that will be applied to each phase of the construction project. (IC Tech Spec – for ICD/ICS 705)

Construction Security Technician (CST): A U.S. Top Secret cleared person specially trained in surveillance and the construction trade to deter technical penetrations and thwart implanted technical collection devices. (IC Tech Spec – for ICD/ICS 705)

Continuous Operation: This condition exists when the secure space is staffed 24 hours every day.

Duress Alarm: A silent alarm signal generated by the manual activation of a device requiring a security force response.

Equipment Room (ER): An environmentally controlled, centralized space for telecommunications equipment that usually houses a main or intermediate cross-connect. (UFC 3-580-01)

Essential Loads: Loads that require standby power, but can be de-energized until they can be supplied from an engine generator system. Loads in this category usually include HVAC loads to vital facilities or other load types that can be de-energized for short periods without severe consequence. (UFC 3-540-01)

Fixed Facility Checklist (FFC): Checklist used by CSAs to determine whether construction requirements have been met.

Inspectable Space. The three-dimensional space surrounding equipment that processes classified or sensitive information within which TEMPEST exploitation is not considered practical or where legal authority to identify and remove a potential TEMPEST exploitation exists. Inspectable space may include parking areas around the facility which are owned or randomly inspected daily by the organization, public roads along which parking is not allowed, heavily wooded or other undeveloped areas with restricted vehicular access, and any areas where U.S. security personnel have unannounced 24-hour access. (DoD 5105.21-M Vol 2)

Open Storage: Storage of classified information within an approved facility where securing classified information in GSA approved storage containers while the facility is not occupied by authorized personnel is not required. (DoD 5105.21-M Vol 2)

Protected Distribution System (PDS): Wire line or fiber optic system that includes adequate safeguards and/or countermeasures (e.g., acoustic, electric, electromagnetic, and physical) to permit its use for the transmission of unencrypted information through an area of lesser classification or control. (CNSSAM TEMPEST/01-13)

RED Equipment: A term applied to equipment that processes unencrypted NSI that requires protection during electrical/electronic processing. (CNSSAM TEMPEST/1-13)

RED LAN: A term applied to equipment, cables, or fiber that processes or carries unencrypted National Security Information (NSI) that requires protection during electrical/electronic processing. (CNSSAM TEMPEST/1-13)

Secure Working Area (SWA): An accredited SCIF used for handling, discussing and/or processing of SCI, but where SCI will not be stored.

Security Environment Threat List (SETL): Classified list managed by the Office of Intelligence and Threat Analysis (ITA). The SETL reflects four categories of security threat, including political violence and crime for U.S. missions overseas.

Site Security Manager (SSM): Person designated for the construction project that is responsible for all aspects of security to include security policy implementation and oversight.

Sensitive Compartmented Information (SCI): Classified information concerning or derived from intelligence sources, methods, or analytical processes, which is required to be handled within formal access control systems established by the Director of National Intelligence.

Sensitive Compartmented Information Facility (SCIF): Accredited area, room, group of rooms, buildings, or installation where SCI may be stored, used, discussed, and/or processed.

Sound Transmission Class (STC): An integer rating of how well a building partition attenuates airborne sound.

Special Access Program Facility (SAPF): An accredited area, room, group of rooms, building, or installation where SAP materials may be stored, used, discussed, manufactured, or electronically processed. (DoDM 5205.07, Volume 3)

Special access program facility accrediting official (SAO): A properly trained SAP facility accrediting official designated by the CA SAPCO to physically inspect and review and approve or disapprove physical security preconstruction plans for a SAPF, T-SAPF, SAPCA, and SAPWA or SAPTSWA before accreditation. (DoDM 5205.07, Volume 3)

Special Security Officer (SSO): The SSO designated by the Senior Intelligence Official for any activity that is accredited for and authorized to receive, use, and store SCI. The activity SSO is responsible, IAW DoDM 5105.21, Volumes 1-3 and ICD 703 for the day-to-day security management, operations, implementation, use and dissemination of SCI within the activity. (DoDM 5200.01, Vol 1)

STC Rating: STC is a single number rating used to determine the sound barrier performance of walls, ceilings, floors, windows, and doors.

TEMPEST: A name referring to the investigation, study, and control of unintentional compromising emanations from telecommunications and automated information systems equipment. (CNSSI No. 4009)

TEMPEST Addendum: An addendum to the FFC that provides information to the CTTA to aid in the determination of what TEMPEST countermeasures, if any, need to be applied. (DoD 5105.21-M Vol 2)

TEMPEST Counter Measure Review (TCR): The review conducted or validated by the Certified TEMPEST Technical Authority to document the recommended TEMPEST countermeasures for the project.

Telecommunications Room (TR): An architectural space designed to contain telecommunications equipment, cable terminations, and cross connect cabling. (UFC 3-580-01)

Telecommunications System: Any system that transmits an analog or digital signal over a physical (cable or wire) or non-physical (wireless) connection. This includes systems such as information technology, control, cable television, electronic security, fire alarm, paging, intercom, public address, and mass notification.

Temporary Secure Working Areas (TSWAs): An accredited facility where handling, discussing, and/or processing of SCI is limited to less than 40-hours per month and the accreditation is limited to 12 months or less.

United States and its territories: The 50 states, the District of Columbia, Puerto Rico, Guam, American Samoa, the United States Virgin Islands, Wake Island, Johnston Atoll, Kingman Reef, Palmyra Atoll, Baker Island, Howland Island, Jarvis Island, Midway Islands, Navassa Island, and Northern Mariana Islands. (DoDM 5200.01, Volume 3)

Uninterruptible Load: Loads that require continuous power and cannot experience even momentary power disruptions. Loads in this category usually involve life safety or include hazardous or industrial process equipment, command, control, computer, data center, and communications systems. (UFC 3-540-01)

U.S. Person: An individual who has been lawfully admitted for permanent residence as defined in 8U.S.C. § 1101(a)(20) or who is a protected individual as defined by Title 8 U.S.C. §1324b (a)(3)). (IC Tech Spec – for ICD/ICS 705)

Vault: A room(s) used for the storing, handling, discussing, and/or processing of SCI and constructed to afford maximum protection against unauthorized entry. (IC Tech Spec – for ICD/ICS 705)

Waveguide: Devices installed at perimeter penetrations that are formed by metal tubing or ducting intended to attenuate wave energy.

APPENDIX C REFERENCES

C-1 GOVERNMENT.

COMMITTEE ON NATIONAL SECURITY SYSTEMS

https://www.cnss.gov/cnss/

Committee on National Security Systems Advisory Memorandum (CNSSAM) TEMPEST/01-13, *RED/BLACK Installation Guidance* (For Official Use Only)

Committee on National Security Systems Instruction (CNSSI) No.4009, *Committee on National Security Systems (CNSS) Glossary*

Committee on National Security Systems Instruction (CNSSI) No.7003, *Protective Distribution Systems (PDS)*

DEPARTMENT OF DEFENSE

https://www.esd.whs.mil/dd/dod-issuances/

Manuals:

DoDM 5105.21-Volume 1, *Sensitive Compartmented Information (SCI) Administrative Security Manual: Administration of Information and Information Systems Security*

DoDM 5105.21-Volume 2, *Sensitive Compartmented Information (SCI) Administrative Security Manual: Administration of Physical Security, Visitor Control, and Technical Security*

DoDM 5105.21-Volume 3, *Sensitive Compartmented Information (SCI) Administrative Security Manual: Administration of Personnel Security, Industrial Security, and Special Activities*

DoDM 5200.01 Volume 1, *DoD Information Security Program: Overview, Classification, and Declassification*

DoDM 5200.01 Volume 2, *DoD Information Security Program: Marking of Information*

DoDM 5200.01 Volume 3, *DoD Information Security Program: Protection of Classified Information*

DoDM 5205.07 Volume 1, *DoD Special Access Program (SAP) Security Manual: General Procedures*

DoDM 5205.07 Volume 2, *DoD Special Access Program (SAP) Security Manual: Personnel Security*

DoDM 5205.07 Volume 3, *DoD Special Access Program (SAP) Security Manual: Physical Security*

DoDM 5205.07 Volume 4, *DoD Special Access Program (SAP) Security Manual: Marking*

Directives:

DoD 5200.08-R (DTM) 08-004, *Physical Security Program*

DoDD 4270.5, *Military Construction*

Instructions:

DoDI 5200.48, Controlled Unclassified Information (CUI)

DEPARTMENT OF THE NAVY

DONSAPCO/0779-22, *Department of Navy Special Access Program Facilities Way Ahead*

DEPARTMENT OF STATE

Best Practices Guidelines for Architectural Radio Frequency Shielding (FOUO)

DIRECTOR OF NATIONAL INTELLIGENCE

https://www.dni.gov/index.php/ncsc-how-we-work/ncsc-ci-security-governance-regulations

Office of the Director of National Intelligence Instruction 80.16, Category 80 - *Information and Records Management*

Intelligence Community Directive (ICD) 703, *Protection of Classified National Intelligence, Including Sensitive Compartmented Information*

Intelligence Community Directive (ICD) 705, *Sensitive Compartment Information Facilities*

Intelligence Community Standard Number 705-1 (ICS 705-1), *Physical and Technical Security Standards for Sensitive Compartmented Information Facilities*

Intelligence Community Standard Number 705-02, *Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities*

Intelligence Community Standard Number 706-02, *Protecting Mission Critical-Facility Related Control Systems (MC-FRCS) in Mission Critical Facilities (MCF)*

IC Tech Spec-for ICD/ICS 705, *Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities*

FEDERAL SPECIFICATIONS

https://quicksearch.dla.mil/qsSearch.aspx

AA-D-600D, *Federal Specification Door, Vault, Security*

FF-L-2740, *Locks, Combination*

FF-L-2890, *Lock Extension (Pedestrian Door, Deadbolt)*

FF-P-110, *Padlock, Changeable Combination (Resistant to Opening by Manipulation and Surreptitious Attack)*

NATIONAL INSTITUTE FOR STANDARDS AND TECHNOLOGY

Federal Information Processing Standard (FIPS) 140-2, *Security Requirements for Cryptographic Modules*

Federal Information Processing Standard (FIPS) 197, *Advanced Encryption Standard* (AES)

NAVAL FACILITES ENGINEERING COMMAND

NAVFAC INSTRUCTION 4700.01, *Planning, Design, and Construction of Navy Sensitive Compartmented Information Facilities*

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

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

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

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

UFC 3-540-01, *Engine-Driven Generator Systems for Prime and Standby Power Applications*

UFC 3-580-01, *Telecommunications Interior Infrastructure Planning and Design*

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

UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems*

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

UFC 4-020-02FA, *Security Engineering: Concept Design* (FOUO)

UFC 4-021-02, *Electronic Security Systems*

UNIFIED FACILITIES GUIDE SPECIFICATIONS

https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs

UFGS 08 34 73, *Sound Control Door Assemblies*

UNITED STATES ACCESS BOARD

https://www.access-board.gov/aba/

Architectural Barriers Act (ABA) Standards

C-2 NON-GOVERNMENT.

THE AMERICAN INSTITUTE OF ARCHITECTS

Architectural Graphics Standards

ASTM INTERNATIONAL (ASTM)

ASTM C1766, Factory-Laminated Gypsum Board

ASTM D1003, Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics

ASTM E336, Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings

ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

GYPSUM ASSOCIATION

GA-600, *Fire Resistance and Sound Control Design Manual*

INTERNATIONAL CODE COUNCIL

https://www.iccsafe.org/

International Building Code (IBC)

NATIONAL FIRE PROTECTION ASSOCIATION

http://www.nfpa.org

NPFA 70, *National Electric Code*

NFPA 101, *Life Safety Code*

NFPA 110, *Standard for Emergency and Standby Power Systems*

UNDERWRITER'S LABORATORIES, INC. (UL)

https://www.ul.com/

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

UL 639, *Standard for Intrusion-Detection Units*

UL 681, *Installation and Classification of Burglar and Holdup Alarm Systems for Alarm System Installation*

UL 864, *Standard for Control Units and Accessories for Fire Alarm Systems*

UL 1034, *Standard for Safety for Burglary-Resistant Electric Locking Mechanisms*

UL 1076, *Standard for Safety Proprietary Burglar Alarm Units and Systems*

UL 1610, *Standard for Safety Central-Station Burglar-Alarm Units*

UL 2050, *National Industrial Security Systems;* UL 2050 materials are restricted and only distributed to those demonstrating relevant national industrial security involvement

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APPENDIX D

DOD 5200.01-V3, ENCLOSURE 3

APPENDIX TO ENCLOSURE 3

PHYSICAL SECURITY STANDARDS

FEBRUARY 24, 2012

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ENCLOSURE 3

STORAGE AND DESTRUCTION

1. GENERAL REQUIREMENTS

a. Classified information shall be secured under conditions adequate to deter and detect access by unauthorized persons. The requirements specified in this Volume represent acceptable security standards. DoDD 5210.56 (Reference (ai)) specifies DoD policy concerning the use of force for the protection of classified information. Do not store weapons or items such as funds, jewels, precious metals, or drugs in the same container used to safeguard classified information. Holdings of classified material should be reduced to the minimum required to accomplish the mission.

b. GSA establishes and publishes minimum standards, specifications, and supply schedules for containers, vault doors, modular vaults, alarm systems, and associated security devices suitable for storing and protecting classified information. DoDI 3224.03 (Reference (aj)) describes requirements for acquiring physical security equipment for use within the Department of Defense.

c. The DNI establishes security requirements for sensitive compartmented information facilities (SCIFs). These are issued by Reference (i) within the Department of Defense.

d. The DoD Lock Program is designated as the DoD technical authority for locking and storage systems used for the protection of classified information. For technical support, call the DoD Lock Program Technical Support Hotline at 1-800-290-7607 or DSN 551-1212 or review the website at https://locks.navfac.navy.mil, for more information.

e. Volume 4 of this Manual specifies storage and destruction requirements for controlled unclassified information.

2. LOCK SPECIFICATIONS. Except as provided elsewhere in this Volume, combination locks on vault doors, secure rooms, and security containers protecting classified information shall conform to Federal Specification FF-L-2740 (hereafter referred to as “FF-L-2740”)(Reference (ak)).

3. STORAGE OF CLASSIFIED INFORMATION BY LEVEL OF CLASSIFICATION. Store classified information not under the personal control and observation of an authorized person, in a locked security container, vault, room, or area, as specified in this section.

a. Top Secret. Top Secret information shall be stored:

(1) In a GSA-approved security container with one of the following supplementary

controls:

(a) An employee cleared to at least the Secret level shall inspect the security container once every 2 hours.

(b) The location that houses the security container is protected by an intrusion detection system (IDS) meeting the requirements of the Appendix to this enclosure with personnel responding to the alarm arriving within 15 minutes of the alarm annunciation.

(2) In a GSA-approved security container equipped with a lock meeting FF-L-2740, provided the container is located within an area that has been determined to have security-in-depth (see Glossary for definition);

(3) In an open storage area (also called a secure room) constructed according to the Appendix to this enclosure and equipped with an IDS with the personnel responding to an alarm within 15 minutes of the alarm annunciation if the area has been determined to have security-in-depth, or within 5 minutes of alarm annunciation if it has not;

(4) In a vault, or GSA-approved modular vault, meeting the requirements of Federal Standard (FED-STD) 832 (Reference (al)) as specified in the Appendix to this enclosure; or

(5) Under field conditions during military operations, using such storage devices or security control measures as a military commander deems adequate to prevent unauthorized access. Military commanders should employ risk management methodologies when determining appropriate safeguards.

b. Secret. Secret information shall be stored by one of the following methods:

(1) In the same manner as prescribed for Top Secret information;

(2) In a GSA-approved security container or vault built to FED-STD 832 specifications, without supplementary controls;

(3) In an open storage area meeting the requirements of the Appendix to this enclosure, provided the senior agency official determines in writing that security-in-depth exists, and one of the following supplemental controls is utilized:

(a) An employee cleared to at least the Secret level shall inspect the open storage area once every 4 hours.

(b) An IDS meeting the requirements of the Appendix to this enclosure with the personnel responding to the alarm arriving within 30 minutes of the alarm annunciation.

(4) In a secure room that was approved for the storage of Secret information by the DoD Component prior to October 1, 1995, provided the DoD Component reassesses the requirement for the secure room and makes plans to bring the room up to the standards of subparagraphs

3.b.(1) through 3.b.(3) of this section by October 1, 2013 and provided the area has been determined to have security-in-depth.

c. Confidential. Confidential information shall be stored in the same manner as prescribed for Top Secret or Secret information except that supplemental controls are not required.

4. RISK ASSESSMENT. When considering the storage alternatives specified in section 3, a risk assessment shall be performed to facilitate a security-in-depth determination and to aid identification and selection of supplemental controls that may need to be implemented. The analysis should, at a minimum, consider local threats, both known and anticipated, and vulnerabilities; the existing security environment and controls; the ease of access to containers or other areas where classified data is stored; the criticality, sensitivity, and value of the information stored; and cost verses benefits of potential countermeasures. The risk assessment shall be used to determine whether installation of an IDS is warranted or whether other supplemental controls are sufficient.

5. U.S. CLASSIFIED INFORMATION LOCATED IN FOREIGN COUNTRIES. Except for classified information that has been authorized for release to a foreign government or international organization in accordance with Reference (z), and is under that government's or organization's security control, U.S. classified material may be retained and stored in a foreign country only when necessary to satisfy specific U.S. Government requirements. The Heads of the DoD Components shall prescribe requirements for protecting this information, paying particular attention to ensuring proper enforcement of controls on release of U.S. classified information to foreign entities. Compliance with the provisions of this enclosure is required. U.S. classified material in foreign countries shall be stored at a:

a. U.S. military installation, or a location where the United States enjoys extraterritorial status, such as an embassy or consulate.

b. U.S. Government activity located in a building used exclusively by U.S. Government tenants, provided the building is under continuous (i.e., 24/7) control by U.S. Government personnel.

c. U.S. Government activity located in a building not used exclusively by U.S. Government tenants which is under host government control, provided that the classified material is stored in GSA-approved security containers which are further secured in a locked room or area to which only U.S. personnel have access and the room or area is under continuous (i.e., 24/7) control by U.S. Government personnel.

d. U.S. Government activity located in a building not used exclusively by U.S. Government tenants nor under host-government control, provided the classified material is stored in GSA-approved security containers and is placed under continuous (i.e., 24/7) control by U.S. Government personnel.

6. SPECIALIZED STORAGE

a. Military Platforms

(1) The Heads of the DoD Components shall, consistent with this Volume, delineate the appropriate security measures required to protect classified information stored in security containers on military platforms (e.g., aircraft, militarized or tactical vehicle) and for classified munitions items.

(2) GSA-approved field safes and special size one- and two-drawer security containers approved by the GSA may be used for storage of classified information in the field and in military platforms. These containers shall use locks conforming to FF-L-2740 or Federal Specification FF-L-2937 (Reference (am)), as required by Federal Specification AA-F-358 (Reference (an)). Special size containers shall be securely fastened to the platform; field safes shall be under sufficient control and surveillance when in use to prevent unauthorized access or loss.

b. IT Equipment. GSA-approved information processing system cabinets are available for protection of operational IT equipment. The cabinets can be used for storage of network equipment (such as routers, switches, and crypto devices), servers, power control units, and laptops and can be configured for rack mounting with interior fans for heat management and cable connections for exterior data transmission and power.

c. Map and Plan File Cabinets. GSA-approved map and plan file cabinets are available for storing odd-sized items such as computer media, maps, charts, and classified equipment.

d. Modular Vaults. GSA-approved modular vaults meeting Federal Specification AA-V-2737 (Reference (ao)) may be used to store classified information as an alternative to vault requirements described in the Appendix to this enclosure.

e. Bulky Material. Storage areas for bulky material containing Secret or Confidential information may have access openings (e.g., roof hatches, vents) secured by GSA-approved changeable combination padlocks meeting Federal Specification FF-P-110 (Reference (ap)). Other security measures are required, in accordance with paragraphs 3.b. and 3.c. of this enclosure.

(1) When special circumstances exist, the Heads of the DoD Components may authorize the use of key operated locks for storing bulky material containing Secret and Confidential information. The authorization shall be documented with an explanation of the special circumstances that warrant deviation from other established standards. Whenever using such locks, administrative procedures for the control and accounting of keys and locks shall be established. The level of protection provided to such keys shall be equivalent to that afforded the classified information the padlock protects.

(2) Section 1386 of title 18, United States Code (U.S.C.) (Reference (aq)), makes

unauthorized possession of keys, key-blanks, keyways, or locks that any part of the Department of Defense adopts for protecting conventional arms, ammunition, or explosives, special weapons, and classified equipment, a criminal offense punishable by fine or imprisonment for up to 10 years, or both.

7. PROCURING NEW STORAGE EQUIPMENT. New security storage equipment shall be procured from those items listed on the GSA Federal Supply Schedule. When GSA-approved security containers or vault doors with locks meeting FF-L-2740 are placed in service or when existing mechanical locks are replaced with locks meeting FF-L-2740, the custodian or security manager shall record the lock serial number on an SF 700, "Security Container Information." For procurement or technical support, call the DoD Lock Program as specified in paragraph 1.d of this enclosure.

8. SECURITY CONTAINER LABELS. GSA-approved security containers must have a label stating "General Services Administration Approved Security Container," affixed to the front of the container, usually on the control or the top drawer.

a. If the label is missing or if the container's integrity is in question, the container shall be inspected by a GSA certified inspector. Information on obtaining inspections and recertification of containers can be found on the DoD Lock Program Website (https://locks.navfac.navy.mil) or by calling the DoD Lock Program at (800) 290-7607 or DSN 551-1212.

b. When the container is being sent to the Defense Reutilization and Marketing Office, the GSA label shall be removed.

9. EXTERNAL MARKINGS ON CONTAINERS. There shall be no external mark revealing the level of classified information authorized to be or actually stored in a given container or vault, or indicating the priority assigned to the container for emergency evacuation and destruction. This does not preclude placing a mark or symbol (e.g., a bar code) on the container for other purposes (e.g., identification and/or inventory purposes) or from applying decals or stickers the DNI requires for containers and equipment used to store or process intelligence information. If a GSA container or vault door recertification is required, such labels and markings must be removed, but may be reapplied as needed after recertification.

10. SECURITY CONTAINER INFORMATION. Maintain a record for each container, or vault or secure room door, used for storing classified information. SF 700 with all information blocks completed, shall be used for this purpose. Update the form each time the security container combination is changed.

a. Part 1 of SF 700 is not classified, but contains personally identifiable information (PII) that shall be protected by sealing Part 1 in an opaque envelope (not provided as part of the SF 700) conspicuously marked "Security Container Information" and stored in accordance with SF

700 instructions. If the information must be accessed during non-duty hours and a new opaque envelope is not available to replace the opened one, the original envelope should be temporarily resealed, to the extent possible, until Part 1 can be placed in a new envelope the next working day.

b. Part 2 of SF 700, when completed, is classified at the highest level of classification authorized for storage in the security container. It shall be sealed and stored in accordance with SF 700 instructions. The classification authority block shall state "Derived From: 32 CFR 2001.80(d)(3))," with declassification upon change of combination.

11. COMBINATIONS TO CONTAINERS, VAULTS AND SECURE ROOMS

a. Protecting and Storing Combinations. In accordance with section 2001.45(a)(1) of Reference (f), the combination shall be classified at the same level as the highest classification of the material authorized for storage in the container.

(1) Use SF 700 Part 2, as specified in section 10 of this enclosure, to record the combination and other required data.

(2) If another record of the combination is made, the record shall be marked as required by Volume 2 of this Manual.

(3) Only a minimum number of authorized persons shall have knowledge of combinations to authorized storage containers, including vaults and secure rooms.

(4) Security containers, vaults, secure rooms and other authorized storage containers shall be kept locked when not under the direct supervision of an authorized person entrusted with the contents.

(5) A record of the names of persons having knowledge of the combination shall be maintained.

b. Changing Combinations. Only individuals with the responsibility and an appropriate security clearance shall change combinations to security containers, vaults and secure rooms used for storing classified information. Combinations shall be changed:

(1) When the container, vault, or secure room door is placed in service.

(2) Whenever an individual knowing the combination to the container or vault door no longer requires access, unless other sufficient controls exist to prevent that individual's access to the lock.

(3) When compromise of the combination is suspected.

(4) When the container, vault, or secure room door is taken out of service or is no longer

used to store classified information, at which time built-in combination locks shall be reset to the standard combination 50-25-50, and combination padlocks shall be reset to the standard combination 10-20-30.

12. ENTRANCES TO OPEN STORAGE AREAS FOR CLASSIFIED INFORMATION

a. When areas storing classified information are occupied by authorized individual(s), the entrances shall either be:

(1) Under visual control at all times to detect entry by unauthorized persons; or

(2) Equipped with an automated entry control system to limit access (see section 3 of the Appendix to this enclosure).

b. Secure rooms or other areas storing classified information shall be secured when the area is not occupied by authorized individual(s) or under continual visual control.

c. The Appendix to this enclosure provides standards for access control devices. Electrically actuated locks (e.g., magnetic strip card locks) do not, by themselves, meet the required standards for protecting classified information and shall not be used as a substitute for the locks prescribed in section 2 of this enclosure.

13. INSPECTION OF STORAGE CONTAINERS PRIOR TO REMOVAL, REPAIR, ETC. Cleared personnel shall inspect storage containers that may have been used to store classified information before removing them from protected areas or allowing unauthorized persons access to them to ensure no classified material remains within.

14. NEUTRALIZATION AND REPAIR PROCEDURES. The procedures described in FED-STD 809 (Reference (ar)) shall be followed for neutralization and repair of security containers and vault doors. Reference (ar) can be found on the DoD Lock Program Website, https://locks.navfac.navy.mil.

a. Neutralization and repair of a security container or door to a vault approved for storage of classified information shall be accomplished only by appropriately cleared or continuously escorted personnel specifically trained in the methods specified by Reference (ar).

b. Neutralization or repair by, or using, methods and procedures other than described in Reference (ar) is considered a violation of the security container's or vault door's security integrity and the GSA label shall be removed. Thereafter, the containers or doors may not be used to protect classified information.

15. STORAGE OF FGI. To the extent practical, FGI shall be stored separately from other

information to facilitate its control. To avoid additional costs, separate storage may be accomplished by methods such as using separate drawers in the same container as other information or, for small amounts, the use of separate file folders in the same drawer.

16. RETENTION OF CLASSIFIED INFORMATION. Classified documents and other material shall be retained within DoD organizations only if they are required for effective and efficient operation of the organization or if law or regulation requires their retention. Documents no longer required for operational purposes shall be disposed of according to the provisions of chapter 33 of Reference (t) and appropriate implementing directives and records schedules, and in accordance with sections 17 and 18 of this enclosure.

17. DESTRUCTION OF CLASSIFIED INFORMATION. Classified documents and material identified for destruction shall be destroyed completely, to prevent anyone from reconstructing the classified information, according to procedures and methods the DoD Component Head prescribes. Methods and equipment used to routinely destroy classified information include burning, crosscut shredding, wet pulping, mutilation, chemical decomposition or pulverizing. Methods used for clearing, sanitization or destruction of classified IT equipment and media include overwriting, degaussing, sanding, and physical destruction of components or media.

a. Documents and other material identified for destruction shall continue to be protected as appropriate for their classification until actually destroyed.

b. Each activity with classified holdings shall establish at least 1 day each year when specific attention and effort is focused on disposing of unneeded classified material (“clean-out day”).

c. Guidance on standards, processes, and procedures for the destruction of COMSEC and other classified material can be found in Reference (r). NATO material shall be destroyed in accordance with Reference (ac). FGI shall be destroyed in the same manner as U.S. classified information of the equivalent level, except where otherwise required by international treaty or agreement. Also see Enclosure 2, subparagraphs 17.b.(7)(a) through (d) for guidance on recording FGI destruction.

d. Effective January 1, 2011, only equipment listed on an evaluated products list (EPL) issued by NSA may be used to destroy classified information using any method covered by an EPL. EPLs currently exist for paper shredders, punched tape destruction devices, optical media destruction devices (for compact discs (CDs) and digital video discs (DVDs)), degaussers (for magnetic media sanitization), and disintegrators (for paper and punched tape material). The EPLs may be obtained by calling (410) 854-6358 or at http://www.nsa.gov/ia/guidance/media_destruction_guidance/index.shtml.

(1) Equipment approved for use prior to January 1, 2011, and not found on the appropriate EPL may be used for destruction of classified information until December 31, 2016.

(2) Unless determined otherwise by NSA, whenever an EPL is revised, equipment

removed from the EPL may be utilized for destruction of classified information for up to 6 years from the date of its removal from the EPL.

(3) In all cases, if any such previously approved equipment needs to be replaced or otherwise requires a rebuild or replacement of a critical assembly (e.g., shredder blade assembly), the unit must be replaced with one listed on the appropriate EPL.

e. Classified IT storage media (e.g., hard drives) cannot be declassified by overwriting. Sanitization (which may destroy the usefulness of the media) or physical destruction is required for disposal. See also section 6 of Enclosure 7 of this Volume.

18. TECHNICAL GUIDANCE ON DESTRUCTION METHODS. Contact the National Security Agency/Central Security Service (NSA/CSS) System and Network Analysis Center at (410) 854-6358 or via e-mail at SNAC@radium.ncsc.mil, to obtain technical guidance concerning appropriate methods, equipment, and standards for destroying classified electronic media, IT equipment, electronic components, and other similar or associated materials.

a. Crosscut Shredders. Only crosscut shredders listed on the "NSA/CSS Evaluated Products List for High Security Crosscut Paper Shredders" (Reference (as)) may be used to destroy classified material by shredding.

(1) The EPL is updated on an as-needed basis as new models are successfully evaluated. Users are encouraged to contact shredders manufacturers and/or distributors for assistance in selecting unit(s) best suited to their requirements. Vendors and/or distributors can provide guidance on whether a specific model not listed meets the specifications in Reference (as) (e.g., for shred size) and, as applicable, a copy of the NSA/CSS letter confirming that the model will be included on the EPL at its next update.

(2) Crosscut shredders currently in use and not on the EPL that were at the time of acquisition on a NSA/CSS evaluated approved products list as being capable of maintaining a shred size of 1/2 inch by 1/32 inch (variance of 1/64 inch) may be used until December 31, 2016 in accordance with paragraph 17.d of this enclosure, EXCEPT for destruction of COMSEC materials. However, any such crosscut shredders requiring replacement of the unit and/or rebuild of the shredder blades assembly MUST BE REPLACED by a crosscut shredder on the latest NSA/CSS EPL. When COMSEC material is destroyed by shredding, ONLY crosscut shredders listed in Reference (as) at the time of acquisition shall be used.

(a) Pending replacement, the Heads of DoD Components shall ensure that procedures are in place to manage the risk posed by crosscut shredders not on the approved NSA/CSS list. At a minimum, the volume and content of each activity's classified material destruction flow shall be assessed and a process established to optimize the use of high security crosscut paper shredders (i.e., with top secret collateral material being the highest collateral priority) to take full advantage of the added security value of those shredders.

(b) The bag of shred must be "stirred" to ensure that the content is mixed up.

(c) Shredding of unclassified material along with the classified material is encouraged.

b. Pulverizers and Disintegrators. Pulverizers and disintegrators must have a 3/32 inch or smaller security screen. Consult the "NSA/CSS Evaluated Products List for High Security Disintegrators" (Reference (at)) for additional details and guidance.

c. Pulping. Pulping (wet process) devices with a 1/4 inch or smaller security screen may be used to destroy classified water-soluble material.

19. DESTRUCTION PROCEDURES

a. The Heads of the DoD Component shall establish procedures to ensure that all classified information intended for destruction is destroyed by authorized means and appropriately cleared personnel.

b. Classified information that cannot be destroyed shall be reevaluated and, when appropriate, downgraded, declassified, or retired to a designated record center.

c. Classified information shall be controlled in a manner designed to minimize the possibility of unauthorized removal and/or access. A burn bag may be used to store classified information awaiting destruction at a central destruction facility. Seal and safeguard each burn bag per this Volume until actually destroyed.

d. Records of destruction are not required, except as noted in paragraph 17.c of this enclosure and, for destruction of classified FGI, in Enclosure 2, subparagraphs 17.b.(7)(a) through (d).

Appendix
Physical Security Standards

APPENDIX TO ENCLOSURE 3

PHYSICAL SECURITY STANDARDS

1. VAULT AND SECURE ROOM CONSTRUCTION STANDARDS

a. Vaults. Vaults shall be constructed to meet Reference (al) as follows:

(1) Class A (concrete poured-in-place).

(2) Class B (GSA-approved modular vault meeting Reference (ao) specifications).

(3) Class C (steel-lined vault) is NOT authorized for protection of classified information.

b. Open Storage Area (Secure Room). This section provides the minimum construction standards for open storage areas.

(1) Walls, Floor, and Roof. Walls, floor, and roof shall be of permanent construction materials; i.e., plaster, gypsum wallboard, metal panels, hardboard, wood, plywood, or other materials offering resistance to and evidence of unauthorized entry into the area. Walls shall be extended from the true floor to the true ceiling and attached with permanent construction materials, mesh, or 18 gauge expanded steel screen.

(2) Ceiling. The ceiling shall be constructed of plaster, gypsum, wallboard material, hardware or any other acceptable material.

(3) Doors. Access doors shall be substantially constructed of wood or metal. For out-swing doors, hinge-side protection shall be provided by making hinge pins non-removable (e.g., spot welding) or by using hinges with interlocking leaves that prevent removal. Doors shall be equipped with a GSA-approved combination lock meeting FF-L-2740. Doors other than those secured with locks meeting FF-L-2740 shall be secured from the inside with deadbolt emergency egress hardware, a deadbolt, or a rigid wood or metal bar that extends across the width of the door.

(4) Windows

(a) Windows that are less than 18 feet above the ground measured from the bottom of the window, or are easily accessible by means of objects located directly beneath the windows, shall be constructed from or covered with materials that will provide protection from forced entry. The protection provided to the windows need be no stronger than the strength of the contiguous walls. Secure rooms which are located within a controlled compound or equivalent may eliminate the requirement for forced entry protection if the windows are made inoperable either by permanently sealing them or equipping them on the inside with a locking mechanism and they are covered by an IDS (either independently or by motion detection sensors within the area).

(b) Windows, which might reasonably afford visual observation of classified activities within the facility shall be made opaque or equipped with blinds, drapes, or other coverings.

(5) Utility Openings. Utility openings such as ducts and vents shall be smaller than man-passable (96 square inches). An opening larger than 96 square inches (and over 6 inches in its smallest dimension) that enters or passes through an open storage area shall be hardened in accordance with Military Handbook 1013/1A (Reference (au)).

2. IDS STANDARDS

a. IDS Purpose. An IDS shall detect an unauthorized penetration into the secured area. An IDS shall be installed when results of a documented risk assessment determine its use as a supplemental control is warranted, in accordance with Enclosure 3, sections 3 and 4 of this Volume, and use is approved by the activity head. When used, all areas that reasonably afford access to the security container or areas where classified data is stored shall be protected by IDS unless continually occupied. An IDS complements other physical security measures and consists of:

(1) Intrusion detection equipment (IDE).

(2) Security forces.

(3) Operating procedures.

b. System Functions

(1) IDS components operate as a system with four distinct phases:

(a) Detection.

(b) Communications.

(c) Assessment.

(d) Response.

(2) These elements are equally important, and none can be eliminated if an IDS is to provide an acceptable degree of protection.

(a) Detection. During the detection phase, a detector or sensor senses and reacts to the stimuli it is designed to detect. The sensor alarm condition is then transmitted over cabling located within the protected area to the premise control unit (PCU). The PCU may service many sensors. The PCU and the sensors it serves comprise a zone at the monitor station (i.e., an alarmed zone).

(b) Communications. The PCU receives signals from all sensors in a protected area and incorporates these signals into a communication scheme. An additional signal is added to the communication for supervision to prevent compromise of the communication scheme (i.e., tampering or injection of false information by an intruder). The supervised signal is sent by the PCU through the transmission link to the monitor station. Inside the monitor station either a dedicated panel or central processor monitors information from the PCU signals. When an alarm occurs, an annunciator generates an audible and visible alert to security personnel. Alarms result normally from intrusion, tampering, component failure, or system power failure.

(c) Assessment. The assessment period is the first phase that requires human interaction. When alarm conditions occur, the operator assesses the situation and dispatches the response force.

(d) Response. The response phase begins as soon as the operator assesses an alarm condition. A response force shall immediately respond to all alarms. The response phase shall also determine the precise nature of the alarm and take all measures necessary to safeguard the secure area.

c. Acceptability of Equipment: All IDE must be Underwriters Laboratories (UL)-listed (or equivalent) and approved by the DoD Component. Government installed, maintained, or furnished systems are acceptable.

d. Transmission and Annunciation

(1) Transmission Line Security. When the transmission line leaves the facility and traverses an uncontrolled area, Class I or Class II line supervision shall be used.

(a) Class I. Class I security is achieved through the use of Data Encryption Standard or an algorithm based on the cipher feedback or cipher block chaining mode of encryption. Certification by the National Institutes of Standards and Technology or another independent testing laboratory is required.

(b) Class II. Class II line supervision refers to systems in which the transmission is based on pseudo-random generated tones or digital encoding using an interrogation and response scheme throughout the entire communication, or UL Class AA line supervision. The signal shall not repeat itself within a minimum 6-month period. Class II security shall be impervious to compromise using resistance, voltage, current, or signal substitution techniques.

(2) Internal Cabling. The cabling between the sensors and the PCU shall be dedicated to IDE and shall comply with national and local code standards.

(3) Entry and/or Access Control Systems. If an entry and/or access control system is integrated into an IDS, reports from the automated entry and/or access control system shall be subordinate in priority to reports from intrusion alarms.

(4) Maintenance Mode. When the alarm zone is placed in the maintenance mode, this condition shall be signaled automatically to the monitor station. The signal shall appear as an alarm or maintenance message at the monitor station and the IDS shall not be securable while in the maintenance mode. The alarm or message shall be continually visible at the monitor station throughout the period of maintenance. A standard operating procedure shall be established to address appropriate actions when maintenance access is indicated at the panel. All maintenance periods shall be archived in the system. A self-test feature shall be limited to one second per occurrence.

(5) Annunciation of Shunting or Masking Condition. Shunting or masking of any internal zone or sensor shall be appropriately logged or recorded in archive. A shunted or masked internal zone or sensor shall be displayed as such at the monitor station throughout the period the condition exists whenever there is a survey of zones or sensors.

(6) Indications of Alarm Status. Indications of alarm status shall be revealed at the monitoring station and optionally within the confines of the secure area.

(7) Power Supplies. Primary power for all IDE shall be commercial alternating or direct current (AC or DC) power. In the event of commercial power failure at the protected area or monitor station, the equipment shall change power sources without causing an alarm indication.

(a) Emergency Power. Emergency power shall consist of a protected independent backup power source that provides a minimum of 8 hours operating power battery and/or generator power. When batteries are used for emergency power, they shall be maintained at full charge by automatic charging circuits. The manufacturer's periodic maintenance schedule shall be followed and results documented.

(b) Power Source and Failure Indication. An illuminated indication shall exist at the PCU of the power source in use (AC or DC). Equipment at the monitor station shall indicate a failure in power source, a change in power source, and the location of the failure or change.

(8) Component Tamper Protection. IDE components located inside or outside the secure area shall be evaluated for a tamper protection requirement. If access to a junction box or controller will enable an unauthorized modification, tamper protection shall be provided.

e. System Requirements

(1) Independent Equipment. When many alarmed areas are protected by one monitor station, secure room zones shall be clearly distinguishable from the other zones to facilitate a priority response. All sensors shall be installed within the protected area.

(2) Access and/or Secure Switch and PCU. No capability shall exist to allow changing the access status of the IDS from a location outside the protected area. All PCUs shall be located inside the secure area and should be located near the entrance. Assigned personnel shall initiate all changes in access and secure status. Operations of the PCU may be restricted by use of a

device or procedure that verifies authorized use. In the secure mode, any unauthorized entry into the space shall cause an alarm to be transmitted to the monitor station.

(3) Motion Detection Protection. Secure areas that reasonably afford access to the security container or area where classified data is stored shall be protected with motion detection sensors; e.g., ultrasonic and passive infrared. Use of dual technology is authorized when one technology transmits an alarm condition independently from the other technology. A failed detector shall cause an immediate and continuous alarm condition.

(4) Protection of Perimeter Doors. When an IDS is installed, each perimeter door shall be protected by a balanced magnetic switch that meets UL Standard 634 (Reference (av)).

(5) Windows. All readily accessible windows (within 18 feet of ground level) shall be protected by an IDS, either independently or by the motion detection sensors within the space, whenever a secure room is located within a controlled compound or equivalent and forced entry protection of the windows is not provided (also see subparagraph 1.b.(4) of this Appendix).

(6) IDS Requirements for Continuous Operations Facilities. A continuous operation facility may not require an IDS. This type of secure area should be equipped with an alerting system if the occupants cannot observe all potential entrances into the room. Duress devices may also be required.

(7) False and/or Nuisance Alarm. Any alarm signal transmitted in the absence of detected intrusion that is not identified as a nuisance alarm is a false alarm. A nuisance alarm is the activation of an alarm sensor by some influence for which the sensor was designed but which is not related to an intrusion attempt. All alarms shall be investigated and the results documented. The maintenance program for the IDS shall ensure that incidents of false and/or nuisance alarms shall not exceed 1 in a period of 30 days per zone.

f. Installation, Maintenance and Monitoring

(1) IDS Installation and Maintenance Personnel. Alarm installation and maintenance shall be accomplished by U.S. citizens who have been subjected to a trustworthiness determination according to Reference (l).

(2) Monitor Station Staffing. The monitor station shall be supervised continuously by U.S. citizens who have been subjected to a trustworthiness determination according to Reference (l).

3. ACCESS CONTROLS

a. The perimeter entrance to a secure facility (i.e., vault or secure room) shall be under control at all times during working hours to prevent entry by unauthorized personnel. This may be achieved by visual control or through use of an automated entry control system (AECS) that complies with the requirements of subparagraph 3.a.(2) of this section. Uncleared persons are to be escorted within the facility by a cleared person who is familiar with the security procedures of the facility. Personnel entering or leaving an area shall be required to secure the entrance or exit point. Authorized personnel who permit another individual to enter the area are responsible for confirming their need to know and access.

(1) Visual control may be accomplished by methods such as designated employees, guards, or continuously monitored closed circuit television.

(2) An AECS may be used if it meets the criteria stated in subparagraphs 3.a.(2)(a) and 3.a.(2)(b). The AECS shall identify an individual and authenticate the person's authority to enter the area through the use of an identification (ID) badge or card.

(a) The ID badge or key card shall use embedded sensors, integrated circuits, magnetic stripes, or other means of encoding data that identifies the facility and the individual to whom the card is issued.

(b) Biometrics verification identifies the individual requesting access by some unique personal characteristic and may be required for access to sensitive information. The Biometrics Identity Management Agency can provide further information regarding biometric technologies and capabilities. Personal characteristics that can be used for identity verification include:

1. Fingerprints.

2. Hand geometry.

3. Handwriting.

4. Iris scans.

5. Voice.

6. Facial recognition.

(3) In conjunction with subparagraph 3.a.(2)(a) of this section, a personal identification number (PIN) may be required. The PIN shall be separately entered into the system by each individual using a keypad device and shall consist of four or more digits, randomly selected, with no known or logical association with the individual. The PIN shall be changed when it is believed to have been compromised or subjected to compromise.

(4) Authentication of the individual's authorization to enter the area shall be accomplished within the system by inputs from the ID badge and/or card, the personal identity verification device, or the keypad with an electronic database of individuals authorized to enter the area. A procedure shall be established for removing the individual's authorization to enter the area upon reassignment, transfer, or termination, or when the individual's access is suspended, revoked, or downgraded to a level lower than the required access level.

(5) Protection shall be established and maintained for all devices or equipment that constitutes the entry control system. The level of protection may vary depending upon the type of device or equipment being protected.

(a) Location where authorization data and personal identification or verification data is input, stored, or recorded shall be protected.

(b) Card readers, keypads, communication or interface devices located outside the entrance to a controlled area shall have tamper resistant enclosures and be securely fastened to the wall or other permanent structure. Control panels located within a controlled area shall require only a minimal degree of physical security protection sufficient to preclude unauthorized access to the mechanism.

(c) Keypad devices shall be designed or installed in such a manner that an unauthorized person in the immediate vicinity cannot observe the selection of input numbers.

(d) Systems that use transmission lines to carry access authorizations, personal identification data, or verification data between devices or equipment located outside the controlled area shall have line supervision.

(e) Electric strikes used in access control systems shall be heavy duty, industrial grade.

(6) Access to records and information concerning encoded identification data and PINs shall be restricted. Access to identification or authorizing data, operating system software or any identifying data associated with the entry control system shall be limited to the fewest number of personnel as possible. Such data or software shall be kept secure when unattended.

(7) Records shall be maintained reflecting active assignment of identification badge and/or card, PIN, level of access, and similar system-related records. Records concerning personnel removed from the system shall be retained for at least 90 days. Records of entries shall be retained for at least 90 days or until investigations of system violations and incidents have been resolved and recorded. Such records shall be destroyed when no longer required in accordance with Reference (u) and DoD Component implementing directives and records schedules.

b. The Heads of DoD Components may approve the use of standardized AECS that meet the following criteria:

(1) For a Level 1 key card system, i.e., a key card bearing a magnetic stripe, the AECS shall provide a .95 probability of granting access to an authorized user providing the proper identifying information within three attempts. In addition, the system shall ensure an unauthorized user is granted access with less than 0.05 probability after three attempts to gain entry.

(2) For a Level 2 key card and PIN system, i.e., a key card bearing a magnetic stripe

used in conjunction with a PIN, the AECS shall provide a 0.97 probability of granting access to an authorized user providing the proper identifying information within three attempts. In addition, the system must ensure an unauthorized user is granted access with less than 0.010 probability after three attempts to gain entry have been made.

(3) For a Level 3 key card, i.e., a key card bearing a magnetic stripe used in conjunction with a PIN and biometrics identifier system, the AECS shall provide a 0.97 probability of granting access to an authorized user providing the proper identifying information within three attempts. In addition, the system shall ensure an unauthorized user is granted access with less than 0.005 probability after three attempts to gain entry have been made.

c. Electrical, mechanical, or electromechanical access control devices meeting the criteria stated below, may be used to control access to secure areas during duty hours if the entrance is under visual control. These devices are also acceptable to control access to compartmented areas within a secure area. Access control devices shall be installed in the following manner:

(1) The electronic control panel containing the mechanism for setting the combination shall be located inside the area. The control panel shall require only a minimal degree of physical security designed to preclude unauthorized access to the mechanism.

(2) The control panel shall be installed, or have a shielding device mounted, so that an unauthorized person in the immediate vicinity cannot observe the setting or changing of the combination.

(3) An individual cleared at the same level as the highest classified information controlled within the area shall select and set the combination.

(4) Electrical components, including wiring, or mechanical links (cables, rods, and so on) shall be accessible only from inside the area, or, if they traverse an uncontrolled area, they shall be secured within conduit to preclude surreptitious manipulation of components.

APPENDIX E

96TH COMMUNICATIONS SQUADRON CYBER INFRASTRUCTURE DESIGN GUIDE

NOVEMBER 2022

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96th Communications Squadron Cyber Infrastructure Standards and Installation Specifications

November 2022

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION IS UNLIMITED

AUTHORITY:

MENSEN.KURANDO.1149434395 Digitally signed by MENSEN.KURANDO.1149434395 Date: 2022.11.06 18:31:56 -06'00'

KURANDO MENSEN, Lt Col, USAF
Commander, 96th Communications Squadron

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Chapter 1

INTRODUCTION

1.1. **Purpose:** The 96th Communications Squadron Cyber Infrastructure Standards and Installation Specifications provides the compliance requirements for Eglin Air Force Base Command, Control, Communications and Computer (C4) requirements. This Cyber Infrastructure typically includes telecommunications spaces, pathways, inside and outside plant cabling and interconnecting Base Area Network (BAN) equipment and Air Force Network (AFNET) components. Therefore, the design of interior and exterior telecommunications infrastructure shall be designed by a Registered Communications Distribution Designer (RCDD) using current Department of Defense, Air Force and industry standards. Moreover, the 96th Communications Squadron Cyber Infrastructure Standards and Installation Specifications provides compliance specifications to those employed or tasked with implementing existing and emerging interior and exterior BAN telecommunications Cyber infrastructure task orders, work orders, contracts, customer information technology and Simplified Acquisition of Base Engineering Requirements (SABER). Furthermore, these specifications shall be used and included as a whole when implementing, engineering, and designing communications requirements in order to meet mission operating and maintenance standards for protecting 96 TW Cyber Space domain.

1.2. **Scope:** These mandatory specification and technical requirements, parts and materials register, and referenced applicable publications contained within this document, shall be adhered to and incorporated within all project designs, contracts and SABER renovations for implementation on the Cyber Infrastructure. Deviation from this guide requires Communications Squadron (CS) approval. The telecommunications contractor(s) herein must coordinate with the 96th Communications Squadron concerning layout and configuration of the BAN. Outside Plant (OSP) is defined as network transportation (copper and fiber) outside a building (e.g., underground or buried) and Inside Plant (ISP) is defined as network transport (copper and fiber) within a building supporting the cyber infrastructure.

1.3. **Communications and Information Systems Officer:** The 96th Communications Squadron, Commander is designated by Technical Order (TO) 00-33A-1001 as the Communications and and Information Systems Officer (CSO) for the base. The 96th CS Commander is the operational and maintaining authority for Cyber Infrastructure that supports the base and tenant units and has final approval over all Cyber Infrastructure C4 processes, procedures, requirements, and installations.

> **NOTE:** The term approved is defined in this document and other standards as acceptable to the authority having jurisdiction.

Chapter 2

TECHNICAL REQUIREMENTS

The following standards and installation specification criteria provides additional installation specification requirements for 96 Test Wing, Eglin AFB. These compliance specific requirements shall be executed IAW Department of Defense, Air Force and industry standards applicable publications and documents referenced within attachment G of this document. In the case of conflicting guidance, defer to the most stringent communications applicable standard.

Contractor and subcontractor(s) are recommended to read and understand the Cyber Infrastructure Standards and Installation Specifications prior to working on or changing the BAN Cyber Infrastructure and should pose any questions to the 96 CS/SCXP, in a formal Request for Interpretation or Information (RFI), for Telecommunications design, product submittals, test results and other communications related issues that may need clarification for a complete understanding.

All coordination shall exist in writing, preferably electronic format using industry standard compatible documentation software available to all parties. i.e., Word or Outlook.

2.1. Land Mobile Radio (LMR) Equipment

2.1.1. **Construction and Renovation:** For new construction and renovation of existing buildings, coordinate with 96 CS/SCXP, Projects and Requirements work center regarding the installation, relocation or removal of any land mobile radio equipment and air-to-ground radio equipment. A Project Manager will provide guidance on the purchase and installation of new equipment, removal and disposition of installed equipment and removal and re-installation of equipment being moved.

2.1.2. **Planning:** For planning purposes, the Eglin LMR infrastructure is currently version 2020HS. All Eglin LMR equipment is tied to the United States Space Force's LMR zone core at Peterson AFB, CO. All changes to the LMR infrastructure will require coordination with AF Installation and Mission Support Center (AFIMSC).

2.1.3. **Subscriber Equipment:** All subscriber equipment intended to operate on the Eglin LMR infrastructure will be compatible and interoperable with the Motorola system. Subscriber equipment will have the required feature set and capabilities required to operate on the Eglin system. Subscriber programming will be completed by the 96 CS.

2.1.4. **Antenna Systems and Cabling:** All radio frequency antenna systems and cabling shall be installed, terminated, protected, and tested based on industry standards, manufacturer instructions and design technical specifications.

2.2. Telecommunication Spaces

2.2.1. **Floor Mount Equipment Cabinet:** All 72-inch or taller cabinet enclosures shall be 4-Post and blend seamlessly into existing or new fixed ladder rack assemblies. In order to support, internal to the cabinet, copper and fiber cable installation; all 4-Post cabinet enclosures shall be outfitted with all necessary cable management accessories IAW Attachment E. All 4-Post cabinet enclosures shall be Great Lakes model GL790ES-2442MS with two sidecars and end panels (P/N SC67942 and P/N SCP7942) cable managers or equal, however customer requirements may dictate the size. All

4-Post cabinet enclosures shall follow the rack elevation layout in Attachment D. All 4-Post cabinet enclosures shall be lockable with unique lock cylinders and corresponding keys turned over to 96 CS that are compliant and only accessible by 96 CS technicians in accordance with Attachment F. Dedicated circuits with electrical receptacles depicted in the rack elevations shall be supplied by onsite contractor and shall be placed in accordance with Attachment D. Exact electrical receptacles shall be identified in all iterations of the design drawings based on customer requirements and any future changes.

Any cabinet requiring fiber patch cables in excess of 6-foot fiber patch cords to access switches shall require horizontal cable management accessories. All Surge Arrestors shall always be 1U higher than the top mounted UPS. In narrow or crowded telecommunication rooms, equipment cabinets shall be floor-mounted adjacent to a wall but shall provide a minimum 36-inches of space both in front of and behind the cabinet and behind any installed equipment. A minimum side clearance of 24-inches shall be provided on end cabinets. Provide 100 percent spare cabinet capacity based on the amount of cabinet capacity utilized by the patch panels provided. Spare cabinets shall be provided for the mounting of Government-purchased/installed LAN equipment, if required. Only 96 CS network equipment shall reside within the confines of 96 CS lockable enclosures in accordance with Attachment F. Wall-mounted cabinets may be utilized in small buildings or smaller areas not conducive for floor mount cabinet enclosures.

2.2.2. **Wall Mount Equipment Cabinet:** All wall mount lockable enclosures shall be Chatsworth ThinLine II Model 13050-723 for low profile or Hoffman Access Plus II, Model EWMS482425 for full size, or equal based on customer requirements mounted to fire rated backboard and grounded IAW para 2.2.11. All wall-mount lockable enclosures shall follow elevation layout IAW Attachment D. Dedicated circuits with electrical receptacles depicted in the rack elevation shall be supplied by onsite contractor and shall be placed IAW rack elevation drawings in Attachment D. Exact electrical receptacles shall be identified in all iterations of the design drawings based on customer requirements and any future changes.

2.2.3. **Information Processing System (IPS) Container:** A SIPR switch not located in an approved classified storage safe, vault, approved open storage area (AKA: secure room), or in a SCIF shall be secured in an IPS container. All IPS containers shall follow elevation layout IAW Attachment D. All IPS containers shall be Hamilton Class 5 Single Door Model 23-36-19 or equal based on customer requirements. Dedicated circuits with electrical receptacles depicted in the rack elevation shall be supplied by onsite contractor and shall be placed in the nearest wall next to the IPS container. Exact electrical receptacles shall be identified in all iterations of the design drawings based on customer requirements and any future changes. End user encryption equipment shall reside outsider the IPS container IAW DISA STIG V-245788 under Traditional Security or most current applicable STIG.

2.2.4. **Network Switches:** All network switches and or network design solutions providing LAN connectivity for NIPR and SIPR shall be specified by 96 CS and funded by the occupying customer.

2.2.5. **Temporary Network Switches**: Temporary switches shall meet all aspects of this Cyber Infrastructure Standards and Installation Specification. Temporary switches shall only remain active for a period of 120 days at which a permanent solution shall be implemented and funded by the occupying customer.

2.2.6. **Voice Networking Services:** All voice networking services will be provided utilizing Voice over Internet Protocol (VoIP). All VoIP devices and equipment to provide voice service shall be specified by 96 CS and funded by the occupying customer.

2.2.7. **Intrusion Detection System (IDS) Services:** All IDS services will be coordinated through the 96 SFS prior to request for installation. SF's IDS provider will engineer a solution based on customer's requirements. Any variation to a fiber solution shall be approved through 96 CS/Authority Having Jurisdiction (AHJ). Customer may be required to purchase IDS Network Switches. Telecommunications design engineer or supporting contractor shall be responsible for incorporating an appropriately sized conduit from IDS provider security panel to the nearest supporting 96 CS communications room. Appropriate CAT-6 plenum-rated cable or fiber optic cable shall be installed inside the IDS supporting conduit to ensure the IDS controller and the supporting IDS switch are interconnected to complete the IDS path. 96 CS personnel will interconnect the cable/fiber in the 96 CS communications room to establish the remainder of the IDS path to the BDOC.

2.2.8. **Copper Patch Panels:** Modular patch panels shall consist of a metal panel that accepts all Panduit Mini-Com® Modules (or equivalent) to mix and match media types in the same panel. Patch panels shall accept all modules for UTP and ScTP applications and shall mount to standard 19" racks. A 1RU cable management panel shall be installed between all equipment and patch panels as necessary.

> **NOTE:** Users must provide and install factory-produced patch cords for work area outlet locations. Patch cables must be CAT-6 "white" to match the horizontal cabling 1-GBASE-T connections.

2.2.9. **Fiber Optic Distribution Panels:** Shall be populated for maximum density utilizing LC type connectors. Optical fiber termination shall use fusion splices with factory produced pigtails for all backbone and premise cabling with a 3-foot slack loop, strain relieve cables at panel and other termination points included with each panel in the Communications Equipment Room (CER).

2.2.10. **Distribution Pathway:** All pathways shall be installed IAW all applicable industry standards. Cable tray shall consist of a ladder type or welded wire cable tray with flat solid bottom or plenum rated tray insert in the telecommunication spaces to provide distribution between the plywood backboard, equipment racks, backbone conduits, and the pathway cable tray. When multiple distributor rooms are located on the same floor, they should be interconnected by a minimum of (2-each 4-inch) conduit or equivalent pathway. The CER distributors shall be dedicated to the telecommunications function and related communications support facilities. These CERs should not be shared with electrical installations other than those supporting telecommunications or associated equipment. Equipment not related to the support of the distributor room (e.g., piping, ductwork, pneumatic tubing) shall not be installed in, pass through, or enter the space.

Cable Installation Clearances:

1. Cables shall not rest upon any other structure not intended for the direct support of the cable(s).
2. Provide minimum clearance of 6-inches from any electromagnetic interference EMI/radio frequency interference RFI sources.
3. Provide minimum clearance of 4-feet from any motor or transformer.
4. Provide minimum clearance of 12-inches from HVAC ducts, flue, hot water, steam line or other heat-producing source.

5. Copper and Fiber cable separation of any classification shall be 3-inches or as designed.

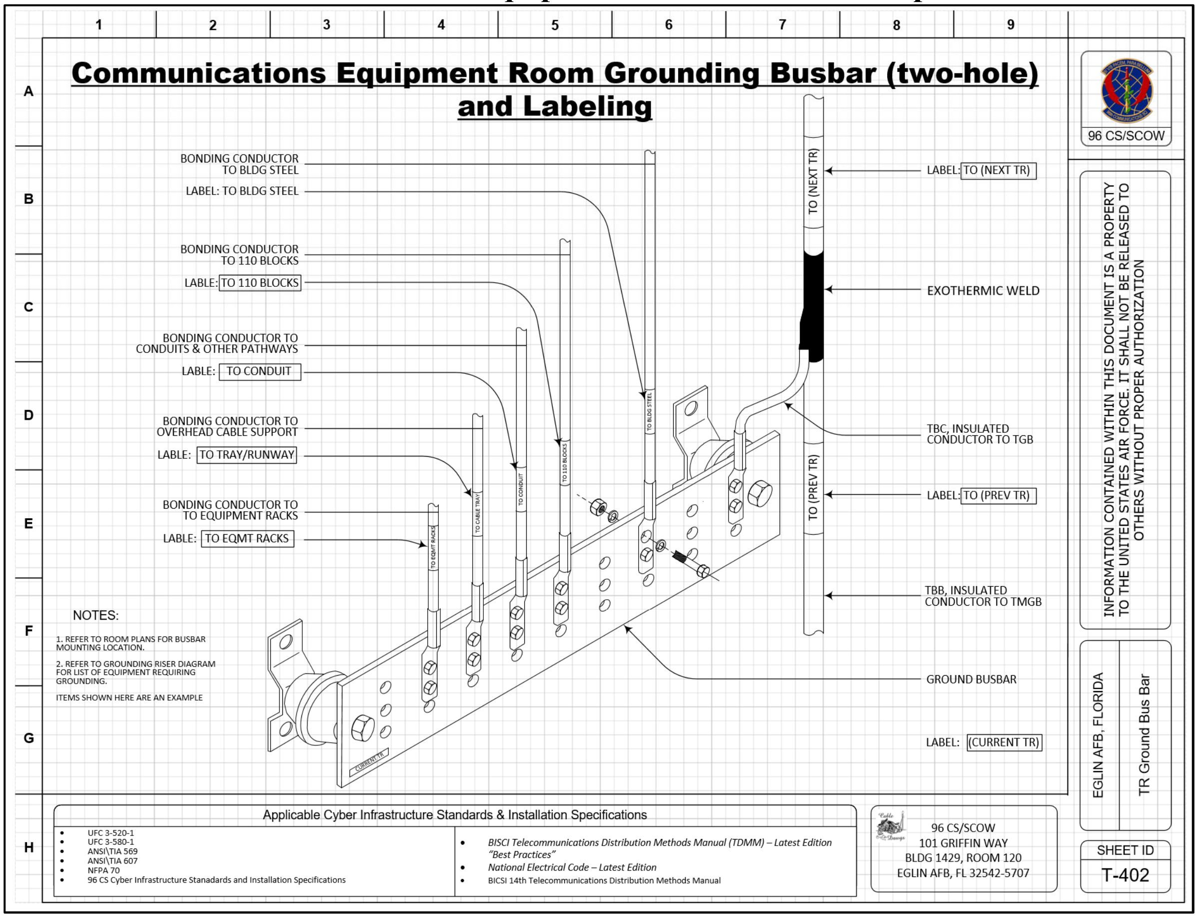
Cable jacket colors: RED - SIPR, BLUE - Wireless, WHITE - Network/VOIP, YELLOW - SCI

Commercial Communications: Commercial ISP services shall be installed and terminated in customer owned spaces only. Commercial OSP/ISP services shall not be housed or routed through any 96 CS CERs, spaces, or communication equipment locations (CEL's). The 96 CS CERs shall not contain any user system equipment or cabling such as ACS, A/V, CCTV, CATV, and similar type systems or networks. Facilities acting as distribution facilities for IDS services supporting IDS connectivity to other outlying facilities shall house the IDS network switch only in the 96 CS CERs. For larger facilities with multiple floors acting as an access or distribution facility, the IDS network switch shall be housed in the 96 CS CERs. IDS network switch(s) shall not be installed in 96 CS communication equipment racks. The IDS controller and supporting IDS panel(s) shall always be housed in end user security or IT room. The 96 CS Comm Rooms will only contain equipment relevant to AFNET maintained systems.

NOTE: Hook and loop straps shall be used to secure/bundle both fiber/copper cables within cable trays, ladders and racks throughout pathway. The hook and loop straps should be evenly spaced (4-feet on center) throughout the dressed length end-to-end. Hook and loop straps shall be used to prevent a change in the physical geometry of the cable that typically results from use of nylon tie wraps. Vinyl tape will not be accepted - Reference drawing T-305:

2.2.11. **Grounding, Bonding, and Shielding:** All grounding shall be performed IAW ANSI/TIA-607 and Rural Utility Services standards. Cyber infrastructure antenna systems, network equipment, OSP/ISP components, cabinets, racks and lockable enclosures shall be grounded to applicable standards.

Communications Equipment Room Busbar Example:



2.2.12. **Work Area Outlets:** All recessed gang boxes and surface mount deep device boxes shall be a minimum of 3.5 inches depth. All faceplates shall be four-port compatible minimum (2-active/2-blanks) feed by a 1-inch EMT stubbed-up to cable pathway above ceiling. Panduit Mini-Com® Classic series (or equivalent) single gang downward sloped faceplate that accepts four modular jacks, off white color. Contractor shall provide fiber and copper cable slack for maintenance within the horizontal cabling system configuration as follows in: CER - cable ladder - UTP/ScTP 10-feet and SM/MM 10-feet, work area outlet - UTP/ScTP 1-foot and SM/MM 3.5-Feet above ceiling. Do not put slack or service loops in communications equipment cabinets or racks. (See attachment G - Applicable Publications)

2.2.13. **Cable Specifications:** All premise wiring supporting NIPR/VoIP/POTS work area outlets shall be white in color and blue for wireless access points (Example: Category 6 UTP Plenum).

NOTE: Unless otherwise specific to support users' classification.

2.2.13.1. All cable subsystems labels shall use a permanent identifier that can be easily traced using methods in Attachment B and ANSI/TIA 606 for other system labeling requirements as described below.

2.2.14. **Existing Legacy**: CAT-3, 5 & 5e cabling shall not be reutilized, relocated, moved or re-terminated for design planning, construction, or renovation. i.e., modular and cubical furniture.

Ensure the Designer of Record (DOR) and Customers are aware of cost/detail requirements prior to Planning, Programming and Budgeting. All Legacy (CAT-3, 5 & 5e) / (OM1) cabling shall be brought to CAT-6/OM3/OM4 or current industry standards and codes during renovations, MILCONs, SABER projects or planned facility upgrades. (See attachment G - Applicable Publications)

2.2.15. **Abandoned ISP Cables:** The accessible portion of all ISP abandoned communications cables shall be removed end-to-end after cut-over and before final inspection. Where cables are identified for future use with a tag, the tag shall be of sufficient durability to withstand the environment involved.

2.2.16. **Labeling Standard:** Label all ISP/OSP telecommunications infrastructure IAW ANSI/TIA 606. Cable tags shall be polyethylene. Handwritten labeling will not be accepted. Stenciled lettering for cable and termination hardware shall be provided using thermal ink transfer process. Existing OSP cable(s) that have been spliced shall be relabeled/retagged back to the origination demarc. Label each ISP cable at both ends (patch panels/work area outlets) within 6-inches of each termination.

2.2.16.1. Use the examples in Attachment B to assist with labeling the cable subsystem on (patch panel to equipment outlet) outlets, and patch panels. From left to right the label reads, Telecomm space feeding outlet. Row letter (if there's one row then it's not needed) rack number. Patch panel elevation letter. Port number on patch panel in sequential order.
2.2.16.1.1. 96 CS prefers using a period between information to save space.
2.2.16.1.2. 96 CS prefers using elevation letter over RU's because older racks aren't marked. (Request deviation approval from 96 CS/SCOW)
2.2.16.1.3. A "/" is authorized between port numbers if all the previous information is the same in the outlet labeling window. i.e., 129.A1.B.47/48.
2.2.16.1.4. Special designator should be placed before port number for anything other than NIPR systems. i.e., DREN, CENTRIX, SIPR
2.2.16.1.5. Each cable, conduit, sleeve and pathway within the ISP shall be labeled showing TO & FROM information.
2.2.16.1.6. All labels shall meet requirements for legibility, defacement, and adhesion, specified in UL 969.
2.2.16.1.7. All outlet jacks, connectors, patch panels, and block hardware shall be labeled.
2.2.16.1.8. All labels must match design and permanent record as-built documentation.

Example:	RM # 129.	Row # A /Rack# 1.	PP# B.	Port# 44
	129.	A1.	B.	44

NOTE: All ISP/OSP requirements stated shall be used unless otherwise specified and approved during design by maintaining organization. ISP/OSP terminations shall be installed IAW all applicable local standards, industry standards and/or manufacturer specifications with the more stringent applying. (See attachment G - Applicable Publications)

2.2.17. **Voice Communications:** Work area outlets shall be installed in all telecommunication rooms, break rooms, mechanical rooms, and entryways that are secured vestibules to support phone installation for safety, courtesy, and convenience purposes. Each CER shall have one wall-outlet installed at or near the entry door for emergency and voice communications.

2.3. **OUTSIDE PLANT (OSP)**

*SEE ATTACHMENT C: FIBER DESIGN NOTES

2.3.1. **Fiber Optic Cables (FOCA):** All OSP cables installed shall be loose tube design with either water block tape or gel filled. All fiber optic cable installed shall be all dielectric with no metallic content. A minimum 24-strand single-mode fiber shall be installed to support core service for all fiber optic installations. FOCA shall be installed for long distances using a figure-8 to prevent twisting and protect the cable when pulling as one piece (home run) without splices between connections except where the distance exceeds the lengths in which cables are manufactured. Fiber cables may be installed by jetting or blown applications using special installed ducts with compressed air. Where splices are required, install splices only in 96 CS approved lockable maintenance communications holes to maximum extent possible. Avoid all unnecessary splicing to prevent excess attenuation and reflection. Follow manufacturer's instructions and pulling tensions. Ensure fibers are installed using strength members "aramid yarn" during installation. Fiber and Copper cables shall not reside together in a 4-inch conduit/duct within the infrastructure, nor shall fiber and copper cabling be installed or exist within the same innerduct or GEO-textile mesh. To maximize comm pathway availability and spacing ensure 4-inch conduit and duct systems are populated with innerduct or GEO-textile mesh before installing any cables. (Reference NECA 301-16)

2.3.2. **Fiber Optic Distribution Panels (FODP) for OSP Termination:** Shall be populated for maximum density utilizing LC type connectors. All new FODP's installed in an Information Transfer Building, Main Access Node, and Communications Equipment Rooms will be capable of housing 288-strand terminations regardless of cable size being installed. All terminations shall be fusion spliced to pre-manufactured cassettes with factory pigtails unless otherwise approved by the maintaining organization. No mechanical terminations shall be used to terminate OSP FOCA.

2.3.3. **Fiber Optic Splice Enclosures:** All fiber optic OSP underground splices shall be encased in a dome type enclosure with a 50-foot service loop for the main cable and 50-foot for each cable serviced by the splice case. Provide an additional 10-foot for racking of cables and splice case. Additionally, every other maintenance hole starting from the entrance MH shall have a 25- foot service loop installed. (Ex. TYCO 450 Fiber Optic Splice Enclosure or equivalent). Direct buried fiber splices shall NOT be allowed for any permanent or temporary communications requirements or fix actions.

2.3.4. **Copper Cables:** OSP copper core cables shall be PE-89 OSP Telephone Cable with an expanded polyethylene (Foam Skin) and external layer of solid, high-density polyethylene. Fiber and copper cabling shall not be installed within the same duct, pathway or mesh/inner ducts at any point. Copper design intra-building and cross-connects terminals from the Point-of-Presence (POP) or DMARC campus backbone for house cabling terminals shall utilize CAT 6 plenum rated UTP for connection/terminations. CAT-3, CAT-5, and CAT-5e cabling solution(s) will not be accepted.

> **NOTE:** An entrance transition point shall be required for unlisted OSP cable when the termination point is greater than (50 feet) from the point of entrance, and the cable cannot be installed in a properly rated conduit (e.g., rigid metal conduit or intermediate metal conduit) or as directed by the authority having jurisdiction. This provision does not apply to a listed indoor/outdoor fire-rated optical fiber cable. The OSP cable can be spliced to a building backbone cable to meet local codes for fire-rated cables.

2.3.5. **Copper Cable Terminations:** OSP copper cable shall be terminated on a Protected Entrance Terminal (PET) 110 type/710 splice connectors or 388 central office connectors with primary protector blocks equipped with 5-pin solid state or gas protector module accessories installed.

2.3.6. **Copper Cable Splice Enclosures:** All copper cable OSP underground splices shall be encased in an appropriate size and type enclosure and installed IAW manufacturer installation guidelines (Ex. Preformed Line Armadillo Stainless Steel Splice Enclosure or equivalent). For Copper OSP no service loop/slack shall be allowed at the terminal or within MHDS. Direct buried cables shall be spliced above ground only in a buried distribution terminal or cabinet for ease of maintenance. Note: Fiber and Copper splices shall be installed in Pre-cast concrete maintenance holes to accommodate the splice case(s) and required splicing service, copper racking and fiber service loop materials.

NOTE: Some splice enclosures may require re-enterable encapsulation compound and shall be determined by the maintaining organization.

2.3.7. **Backboards:** Fire rated Backboards shall be provided on a minimum of two adjacent walls in the telecommunication spaces near cable entry ports. (Backboards) Provide void-free, interior grade A-C plywood ¾-inch thick 4-feet by 8-feet. Backboards shall be fire rated by manufacturing process. Paint applied over fire retardant backboard shall be UL 723 fire retardant paint and identified along with fire stamp clearly visible. Provide label including paint manufacturer, date painted, UL listing and name of Installer. When painted, paint label and Fire Stamp shall be clearly visible. Backboards shall be permanently fastened to the wall by means of wall anchors utilizing stainless steel hardware with a flat head bolt. Finished installation shall be flush. Drywall screws or any other screw types shall not be acceptable.

2.3.8. **Maintenance Holes** (MH)**:** The preferred term for communications underground closures or holes on Eglin AFB shall be "Maintenance Hole or Maintenance Vault", as Manhole or hand hole will not be used. All Maintenance Holes and vaults shall be pre-cast reinforced concrete, multi-directional type with cast-in single or multiple plastic terminators to accept the conduits. Thin concrete knockout sections may be provided for terminating multiple-bore conduits. New MHs shall be placed to support the locations of junction points, offsets, load points, and curvature in the duct line. The contractor shall form and install a 1-foot-wide x 8-inch-deep concrete perimeter around new maintenance holes being installed. The contractor shall ensure the appropriate MHs number is permanently stenciled by the application of paint with 3.5-inch lettering, on the inside top interior within the first 12-inches with a number designated by the 96 CS Authority Having Jurisdiction. All new ducts shall be permanently stenciled by the application of paint with 2-inch lettering on the wall above each duct back and in each building and maintenance hole indicating the connecting building/maintenance hole at the other end of the duct (for example, "To MH-200"). All MHs shall be installed IAW all applicable industry standards.

2.3.8.1. Cast-in-place (site-poured) MHs may be required when overbuilding on existing infrastructure, rebuilding, or enlarging existing MHs that are congested, oddly configured, or contain excessive cables that are improperly routed through the MH.

2.3.8.2. All MHs shall be installed on a leveled, crushed, washed, gravel base of sufficient depth, a minimum thickness of 6-inches under the entire structure and extending past foundation or all outer edges by 6-inches or more, to allow for drainage and stability. In cantonment areas that have or will potentially have multiple cables, they shall not be spaced more than 600-feet apart using the ground plane view. In sparsely populated areas (i.e., range test area) containing only fiber cables, they may be spaced up to 800-feet apart using the ground plain view, providing spacing does not exceed the manufacture's recommended pulling tension for the cables being installed. The above distances (600-feet and 800-feet) may be modified with the approval of the 96 CS. Every effort should be made to implement Jetted or blown fiber optic cabling system designs IAW industry standards to reduce the underground cyber infrastructure and Base Civil Engineering real property footprint towards OSP pathways and maintenance hole requirements. MHs may be placed closer together to accommodate distribution designs when needed. Placed IAW ASTM C891-11 and all other applicable industry and local standards. Accessories shall be designed and provided for use IAW RUS Bulletin 1751F-643, and RUS Bulletin 1753F-151 to support the weight of the cable(s) and splice case(s).

NOTE: Precast polymer concrete or combination of polymers supporting communications cyber infrastructure shall not be utilized on Eglin AFB.

2.3.8.3. New construction shall have a maintenance hole installed within 50-feet of facility telecommunication entrance, CER demarcation point. Furthermore, existing or new conduit feeding a MH or located beyond 50-feet and servicing an Information Transfer Building or Critical Edge Building shall be concrete encased. Additionally, a concrete cap is required when infrastructure backbone cables enter the facility within 40-feet of each other to truly support backbone diversity and protection.

2.3.9 **Maintenance Hole Grounding:** MH shall be grounded in accordance with RUS 1751F 802 and NEC, Article 25, the resistance for OSP grounding shall be nominally 25 ohms. All new MHs installed shall include ground rods and bonding ribbon. The surface mounted bonding ribbon may only be omitted when the following conditions apply:

2.3.9.1 MHs are designed and constructed with an integral ground system with all ironwork bonded together.

2.3.9.2 MHs are identified as containing an integral ground system with a manufacturer's label.

2.3.10. **Main Distribution Maintenance Holes:** The preferred main distribution maintenance holes system interior size is 12-feet (length) x 6-feet (width) x 7-feet. (height) and shall have a load rating of HS-20 for heavy vehicular traffic. (Deviations from this size must be pre-approved by the 96 CS)

2.3.11. **Sub-Distribution Maintenance Holes:** Other size approved for sub-distribution systems depending on location and project design are pre-cast reinforced concrete interior size 3-feet (width) x 5-feet (length) x 4-feet (height) and shall have a load rating of HS-20 for heavy vehicular traffic. (Deviations from this size must be pre-approved by the 96 CS)

Maintenance holes shall be equipped with all accessories to provide complete system:

2.3.11.1. Torsion assisted rectangular diamond plate covers

2.3.11.2. Self-latching stainless steel slam locks

2.3.11.3. 1/8" raised letters stating "COMMUNICATIONS"

2.3.11.4. A sump pan insert for drainage, and a grounding/bonding system

2.3.11.5. Corrosion resistant cable racks

2.3.11.6. Pulling irons

2.3.12. **Concrete Encasement:** In new construction, the duct system shall be concrete encased in all government areas as follows: At a minimum, the duct system shall be encased under all traffic areas; where any bend/sweep exceeds 10 degrees in any direction; in any stream/drainage area subject to washing out; and in major construction zones. Concrete encasement of the ducts for a "core path" shall be required where no alternate paths are present. Concrete encased duct, galvanized RSC, pipe casings, or HDPE duct placed by horizontal directional drilling (HDD) shall also be placed under all paved road surfaces and certain heavy traffic non-surfaced roads as documented in the design package. Concrete forms shall be utilized when encasing ducts into a maintenance hole to limit blockage of empty duct knockouts or windows in the maintenance hole. The encasement/pipe shall be extended a minimum of 6-feet beyond the roadbed for all road crossings. The installer shall use only one brand of Portland cement that conforms to American Society for Testing and Materials (ASTM) C 150. The concrete shall be a wet-type mix and shall be placed in such a manner as to ensure the concrete completely surrounds all ducts and that no air or voids are trapped in the mix. (A dry bag of ready-mix type cement that has not been mixed with water but has been dumped in the trench is not acceptable.) Prior to pouring any concrete over the duct, the installer shall obtain the signature of the on-site U.S. Government AHJ representative to signify the acceptability of the duct placement and spacing. Concrete used to encase conduits shall be a minimum compressive strength of 20,700 kPa (3,000 PSI).

NOTE: Concrete encasement of conduits should be considered for the following conditions:
a. Road or street crossings having earth covers that are equal to or less than 30-inches
b. Railroad crossings
c. Earth covers parallel to and within street, highway, or road travel areas that are less than 30-inches
d. Stream crossings, storm canals, ditches, ponds, parking lots and heavy vehicle traffic areas.
e. Bend angles of 20-degress or greater in conduit lengths equal to or greater than 550-feet

2.3.13. **Duct Placement:** New ducts shall be swept down and installed in the lowest available duct positions within the lowest available duct window in the MH. Duct placement shall not prevent placement of future ducts in the upper duct positions. Conduits shall terminate in bell ends or duct terminators at the point of entrance into the MHs and buildings. Main conduits entering poured-in-place or precast MHs shall be located in the lower portion of the end wall and centered between end walls. Conduits entering sidewalls shall be located a minimum of 4-inches from the end walls that are located farthest from the central office or serving node. Clearances of 12-inches should be maintained between main conduit formations and the roofs or floors of MHs unless the construction drawings indicate otherwise, wall recesses shall be provided at conduit entrances. Subsidiary conduits entering MHs shall be located to provide clearances of 4-inches from roofs and adjacent walls.

2.3.14. **Four Inch Duct Fill:** A minimum of one 4-inch or larger conduit/duct installed in any given duct bank/system shall be populated with three each, 3-inch, three cell geotextile for maximum cable placement. (Other sizes/options may be used only with 96 CS pre-approval.) When installing conduits near other ducts or electrical, installers shall provide a minimum concrete separation of 3-inches or dirt separation of 12-inches. When installing conduits/ducts parallel other utilities, provide separation of 6 and 12-inches respectively. Other direct buried or underground utilities systems shall not be installed above or over-the-top any communications cables.

2.3.15. **Rerouting of Existing Ducts:** Existing ducts shall be joined to new MHs (pre- cast or cast-in-place) by rerouting the designated ducts from the demolished or abandoned MH to the new MH. Rerouting shall begin 30-feet from the old MH, to allow for standard bending radius and pulling tension. Continuity of operations on the affected cables shall be maintained during the duct rerouting actions.

2.3.16. **Pull String, Rope, and Tape:** A pull string, pull rope, or pull tape rated at not less than 600-lbs (2700-newtons (N)) tensile strength shall be installed in each new individual conduit, duct, and/or sub-duct. A minimum of 5-feet shall be provided at each end of the conduit. The string/rope/tape shall be coiled and secured to the closest maintenance hole rack or pulling eye in such a manner as to prevent it from being accidentally pulled back into the duct.

2.3.17. **Plugs:** All ducts, sub-ducts, HDPE roll pipes and innerducts, whether main or subsidiary runs, shall be plugged using universal duct plugs or removable putty sealants in all MHs, vaults and building entrances. Foam sealant is **not** acceptable in a building. Outdoor-rated ducts (sub-ducts, etc.) entering a building will be fire-stopped IAW the National Electrical Code, local codes, and per manufacturer's instructions.

2.3.18. **Duct and Acoustical Sealants**: The area between the entrance conduits and the penetrated floors and/or walls of a building or MH shall be sealed to be waterproof or shall be fire-stopped as appropriate. Use of hydraulic cement between the duct and wall is acceptable for waterproofing the duct entry point.

2.3.19. **Duct Tie-Downs**: Duct systems to be concrete-encased shall be tied down to eliminate movement of the duct system during the placement of concrete. All sections of conduit systems to be concrete-encased shall be tied down using an industry recognized method such as metal rods (four stakes) and metal strapping (for securing the duct system). The metal strapping shall be wrapped completely around the conduit structure and securely attached to the metal rods. The metal rods shall be a minimum of ¼-inch thick. Rods will be driven into the ground a minimum depth of 12-inches and the ducts shall be tied down every 10-feet or closer

2.3.20. **Conduit Spacers**: Spacers shall be installed at minimum of one spacer every 5-feet on center. The duct shall not be damaged, cracked, or crushed prior to or during installation:

2.3.20.1. Ensure the integrity of the orientation of the duct bank between MHs. Do not allow the ducts to twist or tangle between MHs.

2.3.20.2. Ducts that are classified as stub-outs shall be plugged inside the MH or building; tagged, identifying them as stub-outs; and capped on the far end to prevent soil and water from entering the duct. An orange communications locator ball shall be placed at the stub-out end location to facilitate future locating of the stub-out.

2.3.21. **Joints and Connectors:** Ducts shall be joined using manufacturer specific requirements and industry standard such as RUS/ANSI/TIA, to ensure complete end-to-end watertight system and connections. Joints shall not be damaged when pulled past the joint. Joints between dissimilar types of ducts (PVC, HDPE, galvanized steel pipe (GSP), EB, DB, etc.) shall use the appropriate connectors designed for the purpose of providing a seal between the ducts and preventing damage to cables pulled through these joints. All joint surfaces shall be prepared IAW the manufacturer's instructions, and, at a minimum, the mating surfaces shall be wiped clean before they are joined. Locating marker balls shall be placed at all HDPE splice points or duct system repairs.

2.3.22. **Bends and Sweeps:** Accomplish changes in the direction of runs exceeding a total of 10-degrees, either vertically or horizontally, by long sweeping bends having a minimum radius of 20-feet. Long sweeps may be made up of one or more curved or straight sections and/or combinations thereof. Bends made manually shall not reduce the internal diameter of the conduit. There shall be no more than the equivalent of two 90-degree bends (180-degrees total) between pull points, including offsets and kicks with a curvature radius of less than 10-feet. Back-to-back 90-degree bends shall not be utilized. NOTE: Use a large sweep bend that does not abruptly turn the corner. A sweep bends should have a much larger radius then a standard elbow, this allows for improved cable installation.

NOTE: All bends, sweeps, couplers, bend radius/angles, bell ends, adapters, and connection points shall be inspected during construction and prior to burial, concrete encasement or back-filling operations by 96 CS representative to signify the acceptability of installation, placement, and spacing requirements. Follow Rural Utility Services Underground Plant Design, Underground Plant Construction, Construction of Buried Plant, and ANSI/TIA-758-B Customer-Owned Outside Plant for reference.

The following definitions apply:

2.3.22.1. **90-degree bend:** Any radius bends in a piece of pipe that changes the direction of the pipe by 90 degrees.

2.3.22.2. **Kick:** A bend in a piece of pipe, usually less than 45-degrees, made to change the direction of the pipe.

2.3.22.3. **Offset:** Two bends usually having the same degree of bend, made to avoid and obstruction blocking the run of the pipe.

2.3.22.4. **90-degree sweep:** A bend that exceeds the manufacturer's standard size 90-degree bend (e.g., 24-inches is standard for 4-inch conduit).

2.3.22.5. **Back-to-back 90-degree bend:** Any two 90-degree bends placed closer together than 10 feet in a conduit run. Utilize radius-manufactured bends to the maximum extent possible. Manufactured bends may be used on subsidiary/lateral conduits at the riser pole or building entrance. Manufactured bends shall have a minimum radius of 10-times the internal diameter of the conduit IAW Chapter 9 of the National Electrical Code and the ANSI/TIA-758 standard. Bends and sweeps shall be concrete encased to protect the duct from the pressures developed while pulling cables. Where a duct enters a building and sweeps up through a floor slab, galvanized RSC shall be used. For ducts transitioning from the lower duct window of a maintenance hole to the nominal trench depth, the transition shall be accomplished in no less than 30-linear feet from the maintenance hole in order to reduce the radius of the bends. The duct shall be concrete encased in the transition area.

2.3.23. **Section Lengths:** Without prior U.S. Government AHJ approval, the section length of conduit shall not exceed 600-feet between pulling points in main conduit runs. The section length of duct is limited mainly by the size of the cable to be pulled into it and by the number of bends it shall contain.

2.3.24. **Minimum Duct Bank Sizing:** Duct bank sizing shall be a minimum of 4-inches for each design, build, construction and renovation application:

2.3.24.1. The minimum sizing for new duct banks is listed below. The total number of conduits required shall be determined, including existing conduits, conduits installed by this effort, and known future requirements, along with 50-percent of this total for spares.

2.3.24.2. Ducts between the cable vault and the first maintenance hole shall be based upon the size of the switch, the number of outside cable pairs served from the switch location, the FO requirements, and future growth.

2.3.24.3. A main duct run includes the maintenance holes and ducts from a DCO or node and provides the pathways for large feeder cables and/or core FOCs. New main duct runs shall consist of a minimum of 6-way, 4-inch duct banks.

2.3.24.4. A lateral duct run is defined as a minor branch run from the main duct run between maintenance holes. New lateral duct runs shall be a minimum of four-way, 4-inch duct banks.

2.3.24.5. Entrance ducts are defined as ducts from a maintenance hole or hand hole to an Edge-Building (EB). New EB entrance ducts shall be a minimum of two-way, 4-inch duct bank.

2.3.24.6. Entrance conduits in minor buildings, as listed in the design package, shall be a minimum of two-way, 4-inch ducts if the entrance cables are less than one-inch in diameter and if less than 40-percent of the duct area shall be used.

2.3.24.7. In accordance with the National Electrical Code, cables entering a building from the outside and not rated for inside plant use may not extend beyond 50-feet from the cable's point of entry into the building. The point of entry is defined as the point at which the cable penetrates the exterior wall or floor. The point of entry for metallic cables may be extended beyond the 50-foot limitation by using either rigid metal conduit (RMC) or IMC, both of which shall be grounded. Electrical metallic tubing shall not be used for extending the point of entry of metallic cables (transmission media, shields, or strength members). The point of entry for non-metallic cables may be extended using EMT or PVC. Refer to the National Electrical Code, Sections 770.50 and 800.50.

2.3.25. **Depth of Cover:** At least 36-inches of cover are required above the top of the duct bank. At least 24-inches of cover are required under roads or sidewalks (if duct is concrete-encased). For ducts installed in solid rock, the cover shall consist of at least 6-inches of concrete. If rock is encountered below grade, the minimum cover above the concrete-encased duct shall be 12-inches.

2.3.26. **Trench Width:** The installer shall engineer the trench width to the minimum width required to support the size of the duct bank being installed. When installing ducts, the trench width depends on the number of ducts, size of ducts, arrangement of ducts, and space around ducts (at least 2-inches). Additional width may be required to work in deep trenches or with large-count duct banks. Shoring of walls or sloping shall be performed as required by the OSHA and/or local requirements. The trench width for direct buried conduit shall be of sufficient width to permit tamping of dirt on the sides of the conduit formation. (See attachment H - Standard Installation Specification Drawings)

2.3.27. **Split Duct:** Pre-manufactured split ducts shall be of adequate material and approved by the AHJ. Installation shall be done IAW all manufacturer and industry standards.

2.3.28. **Existing Ducts:** Existing vacant ducts that are to be used in new cable installations, as defined in the design package, shall be cleaned and tested with a test mandrel to detect any obstructions, collapsed ducts, or duct inconsistencies. The installer may need to repair damaged ducts by installing new ducts with couplers, split ducts or cured in place pipe lining solutions

2.3.29. **Marking/Warning Tape:** The tape shall be a minimum of three inches wide and orange in color with the appropriate warning message and shall not be utilized as the sole tracing capability. Locating tape/wire shall be installed 18-inches above any communications cable or duct system. Copper wire installed in self-supporting duct shall be minimum 14-gauge and shall not be utilized as the sole tracing capability. Shall be installed IAW all applicable standards.

2.3.30. **Trace-Safe (or Equivalent):** Install 24-inches below finished grade directly over the duct banks and 12-inches below the “marking/warning tape”. All new Trace-Safe (or equivalent) systems installed shall use an approved splice, termination end, connectors, etc.… where needed and an approved label installed at all wire ends. Each wire end shall be secured to the MHs walls within 6-inches of the top of the maintenance hole, accessible without having to enter the hole and not connected to grounds.

2.3.32. **Tracer Wire Installation:** Install ½-inch duct with a single 14 AWG minimum copper wire. Copper wire shall be continuous throughout the duct system and secured to the MHs walls within 6-inches of the top of the MHs, accessible without having to enter the hole and not connected to grounds. The tracer will be secured to the MHs wall and tagged with a label indicating it as a “Tracer Wire to xxx - Do Not Remove” (where xxx is the other end of the wire). Tracer Wire entering any facility shall be grounded IAW applicable standards. Any deviations from this section requires AHJ approval.

2.3.33. **Marker Poles:** Two route markers shall be installed at every maintenance hole. Additional markers are required along all communications pathways at a maximum of 500-feet, line- of-sight or less; whichever is shorter and/or at each change in route direction, on both sides of street crossings. Stenciled at the top section of each marker pole:

“*CONTACT EGLIN BASE COMMUNICATIONS PRIOR TO EXCAVATION AT 882.2581”*

2.3.34. **Duct and Conduit Mandrelling Requirements**

2.3.34.1. Mandrel inspections are a requirement under industry standards for quality control. Prime/Contractor of record shall provide reports on all mandrel tests accomplished for record to ensure compliance with industry standards noted herein.

2.3.34.2. New ducts in main and subsidiary duct runs shall be mandrelled before pulling anything into the duct system. If a design will require installing new cable in existing, empty duct, the OSP designer should consider requiring a mandrel test of the existing duct before installing the cable to verify that the duct is usable.

2.3.34.3. Prior to pouring concrete over the duct, the installer shall obtain the signature of the on-site 96 CS representative to signify the acceptability of the conduit mandrelling, placement and spacing.

2.3.34.4. Duct Cleaning: Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is ¼-inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of two times or until less than a volume of 8 cubic inches of debris is expelled from the duct. Do not install cables in ducts without an approved witness test and written approval of the 96 CS. (See attachment G - Applicable Publications)

Chapter 3

DELIVERABLES

The Contractor shall submit all applicable deliverables and test reports and as-built for review 15-duty days prior to final test and acceptance inspection to the 96 CS/SCXP, Projects and Requirements work center.

3.1. **Fiber and Copper Verification Tests**

3.1.1. **Factory Reel Test/Inspection:** The contractor/installer shall provide a copy of the reel tests/physical inspection reports of factory delivered cable(s) verifying good condition upon delivery.

NOTE: 96 CS review/approval of reel tests/physical inspection reports of factory delivered cable(s) is not required.

3.1.2. **Pre-Installation Tests:** This testing phase is the sole responsibility of the contractor/installer and should be performed prior to the installation of any ISP/OSP cable(s) as to baseline fiber or copper quality before installation.

3.1.3. **Post-Installation Test:** The contractor/installer shall perform final configuration post-installation test and provide all tests results to 96 CS 15-days prior to final QA inspection of all installed ISP/OSP cabling.

NOTE: Optical fibers or copper cable(s) found with damage or defective strands or pairs, shall be replaced (from end to end) and will not be accepted by 96 CS Authority Having Jurisdiction (AHJ).

3.1.4. **Copper Testing:** End-to-end testing for Unshielded Twisted Pair/Screened Twisted Pair (UTP/ScTP) copper shall be conducted for 100-percent of pairs and shall identify any discrepancies. All new UTP/ScTP copper installations shall be free from any and all cable faults or splicer's errors to allow for 100-percent cable usage. Cat-6 network ISP wiring will require a test report showing DB loss, head room, wire map, length, delay skew, and attenuation. The test results shall be documented, corrections implemented, and retesting conducted and documented as required. In addition, documentation shall be presented to show the length of the cable between the telecommunications room and the work area. Testing shall be per industry standards. Copper cabling shall be tested 100-percent (All Pairs) for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but prior to being cross connected (See attachment G - Applicable Publications)

NOTE: Test report results shall reflect the wiring scheme that was selected during design/installation (i.e. 568A or 568B). Fiber and Copper test equipment **<u>must be</u>** calibrated within one year of installation use or test requirements. Test results shall be test equipment exported products from calibrated device only. No handwritten or typed out results will be accepted. All test cables shall be factory made.

3.1.6. **Fiber Testing:** All testing shall be accomplished IAW all applicable industry standards. Attenuation testing for optical fiber shall be performed and documented 1) from manufacturer, 2) upon delivery acceptance/prior to installation, 3) after cable placement/post installation and 4) after all splicing/end terminations have been completed. Any errors or above allowable loss readings will be repaired to bring the faulted fibers to within acceptable parameters. No additional splicing will be allowed in lieu of fiber end-to-end replacement due to manufacturer or installation damage. All strands are to be usable and free of errors providing 100-percent cable usage. Test Results: Certification of the cable(s) being tested is required to ensure it meets/exceeds requirements.

3.1.6.1. Perform 100-percent verification acceptance test for single-mode and multi-mode optical fibers, (all strands) end-to-end attenuation tests IAW OFSTP-14, OFSTP-7, TIA-568-C.3 and TIA-526-7.

3.1.6.2. Installer shall use Tier One Testing using an Optical Power Meter and Light Source for all Inside Plant (ISP) single-mode and multi-mode optical fibers. in a bi-directional manner. Fiber test equipment must be calibrated within one year of installation.

3.1.6.3. Installer shall use Tier Two Testing using an Optical Time Domain Reflectometer (OTDR) and Optical Power Meter and Light Source for all Outside Plant (OSP) single-mode and multi-mode optical fiber in a bi-directional manner. Fiber test equipment must be calibrated within one year of installation. All launch and test cables shall be factory made with lengths for OTDR 150-meters (SM/MM) and light source/power meter 7-feet (SM/MM).

NOTE: Optical fibers or copper cable(s) found with damage or defective strands, or pairs will not be accepted by 96 CS Authority Having Jurisdiction (AHJ) and shall be replaced (from end to end).

3.2. **As-Built Documentation:** The installer shall provide accurate As-Built documentation of the entire OSP and ISP install system to include schedule T-5 documentation (i.e., rack elevations, cable route drawings “T-Sheets”). The Telecommunications Contractor(s) of Record shall maintain “red-lined” drawings at the job site under direct control of the Site POC. The red lines shall represent changes made.

As a minimum, the following information will be on each drawing for OSP/ISP requirements:

3.2.1. Accurate, reasonable facsimile of the OSP/ISP cable pathways and maintenance hole duct/cable tray system as installed
3.2.2. Accurate, reasonable facsimile of the building floor plan
3.2.3. Room and area numbers assigned for identification purposes
3.2.4. Location and designation of all CERs
3.2.5. Telecommunication Room Layout diagram for all CERs
3.2.6. Location and designation of all work area outlets installed
3.2.7. Rack elevations
3.2.8. Location of all vertical/horizontal penetrations
3.2.9. Routes for all cables, including horizontal, tie, and backbone
3.2.10. Location of vertical/horizontal penetrations through firewalls/floors
3.2.11. Geospatial data of new outside plant distribution system with accuracy of the GNSS points no more than 6-12-inches after differential correction/post-processing
3.2.12. Drawing Reference Details (ANSI/TIA 606)

T-1 - Layout of complete building per floor showing: Building area/serving zone boundaries, backbone systems, and horizontal pathways.
T-2 - Serving zone/building area: Drop locations and cable identification.
T-4 - Typical Details: Faceplate labeling, fire stopping, symbols, installation procedures, detail racking and raceways data.
T-5 Schedule: Documentation on cables showing cut overs and cable management, patch panel layouts, faceplate assignments, cross-connects information, and terminal layout as a minimum.

3.3. **Shape Files:** The installer shall provide Global Navigation Satellite System (GNSS) collected OSP infrastructure features and communications pathways attribute, metadata, and location information shall be converted to, stored, and submitted in an Environmental Systems Research Institute (ESRI) Shape File format. The shape files must be compatible with the Cyberspace Infrastructure Planning System (CIPS) Visualization Component (CVC) web-based application. The shape files shall have a geospatial reference (.prj, .dbf, .shp, .shx and .cor) files included that specifies the parameters of the coordinate system. (See Attachment A for more information)

NOTE: Installer(s) shall coordinate with the 96 CS/SCXP office through a Request for Information (RFI) to ensure they have the latest data dictionary before accomplishing any project GIS actions. The accuracy of the GNSS points shall be no more than 6-12-inches after differential correction/post-processing.:

Coordinate system: UTM
Zone: 16 North
Datum: NAD 1983(conus)
Coordinate units: Meters
Altitude units: Meters
Altitude Reference: HAE

3.4. **Test and Acceptance Documentation (AFTO 747):** The Contractor shall submit all test reports and as-built deliverables for review 15-duty days prior to final test and acceptance inspection. The test reports shall show the tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. As-builts shall show all communications pathways, cabling with correct labeling as installed. The contractor shall correct any errors or performance deficiencies detected by testing. The assigned 96 CS/SCXP Project Manager will sign an AFTO Form 747 in Block 11A upon government QA acceptance of contractor's final test results. The 96 CS reserves the right to refuse final acceptance until all discrepancies have been resolved to the satisfaction of the Authority Having Jurisdiction.

3.5. **Projects, Designs, USACE, SABER Requirement Support Timelines:**

3.5.1. **Task Timelines:** Once accepted by SCX and SCO production work center(s).
3.5.1.1. Survey Inputs: 96 CS 5 full duty days (internal use only SCX 1/SCO 4)
3.5.1.2. Project/Design Reviews: 96 CS 12 full duty days (internal use only SCX 2 /SCO 10)
3.5.1.3. Comm path segment verifications: 96 CS 13 full duty days (internal use only SCX 1 / SCO 12)
3.5.1.4. Product submittals: 96 CS 6 full duty days (internal use only SCX 1/SCO 5)
3.5.1.5. Official Request for Interpretation (RFI): 96 CS 5 full duty days (internal use only SCX 1/SCO 4)
3.5.1.6. Request for Escort: 96 CS 5 full duty days (internal use only SCX 1/SCO 4)

3.5.1.7. Deliverables documentation reviews (Shape files, As-built, final test results, reviews: 96 CS 17 full duty days prior to final inspection (internal use only SCX 2/SCO 15)
3.5.1.8. Fiber and copper in-progress test result: 96 CS 9 full duty days (internal use only SCX 1 / SCO 8)
3.5.1.9. Request for in-progress checks or final inspections: 96 CS 6 full duty days (internal use only SCX 1/SCO 5)
3.5.1.10 Rough Order Magnitude (ROM): 96 CS 23 full duty days (internal use only SCX 3/SCO 20)

NOTE: It is imperative on each requirement the 96 CEG, USACE, etc. project manager(s) notifies the required 96 CS discipline in a timely manner.

Chapter 4

PARTS AND MATERIALS REGISTER

The salient physical, functional, and performance characteristics of the following telecommunication parts and materials specified shall be adhered to for all installations or like items. Replacement parts shall be standard and readily available through commercial means. Discontinued products will not be accepted unless approved by the Contracting Officer and 96 CS Authority Having Jurisdiction:

NOTE: The term approved is defined in this document as acceptable to the authority having jurisdiction.

4.1. **Data Jack:** Category 6, RJ45, 8-position, 8-wire UTP Mini-Com® universal jack module has TG-style termination. Off white (or equivalent).

4.2. **Blank Inserts:** Mini-Com® 1-port blank module, reserves space for future use, White (or equivalent).

4.3. **Surface Mount Raceway System:** Tamper resistant two-piece latching surface raceway. Supplied with pre-punched mounting holes and factory applied adhesive tape. Available in 6', 8', and 10' lengths, Off White. Compatible with surface mount outlet box. All surface mounted raceway systems shall be screwed to the wall in addition to the adhesive tape to prevent detachment from the mounted surface.

4.4. **Riser CAT-6:** CAT-6 (600MHz), 4-Pair, U/UTP-Unshielded, Riser-CMR, Premise Horizontal Cable, 23 AWG Solid Bare Copper Conductors, Polyolefin Insulation, X Spline, Ripcord, PVC Jacket.

4.5. **Plenum CAT-6:** Copper Cable, Giga SPEED XL 2071E, 23 AWG, 4 Pair, Unshielded, UTP, Solid Bare Copper Conductor, FEP/PVC, CMP, (WHITE) jacket. Plenum CAT-6: Copper Cable, Giga SPEED XL 2071, 23 AWG, 4 Pair, Shielded, ScTP, Solid Bare Copper Conductor, FEP/PVC, CMP, (RED).

4.6. **Intra-Building Distribution Cables:** Used after 15m (50ft) of “exposed” outside plant copper cable enters building. “Fold back” splicing method preferred.

4.7. **25-pair – 3600-pair:** CMR rated. Pair count varies. Use applicable count determined by the pair count from the outside plant cable.

4.8. **Splice Enclosure:** An intra-building splice closure is a strong, lightweight, fire-retardant covering that protects non-pressurized splices. The closure shields the splice against humidity and moisture and may even resist temporary immersion in water. When you install the closure, properly support it, ground it and test it for air leaks according to manufacturer's recommendations. Affix labels to all cables entering the splice, indicating cable number and pair counts. Clearly designate the "In" and "Out" for the spliced cables.

4.9. **Building Station Terminal Blocks (110-Type):** Terminates intra-building cables and horizontal cables. Must clearly label intra-building cable using stencils above 110 type (IDC) block with applicable information during pre-installation survey.

4.10. **Building Entrance Terminal Blocks (110-Type):** 16 AWG steel building entrance terminals feature an industry standard 110 - style connector for both the input and output terminals. Also included are multiple external and internal ground lugs. UL approved standard on all terminals and standard 5-pin protection modules.

4.11. **Cat-6 Connector Block 24/48 Port (Patch Panel):** Constructed for maximum strength and durability. Rack-mount modular panels shall include an integrated cable management requirement for cable routing and strain relieve cables at patch panel and other termination points. Provide a complete modular system from patch panel to work area outlet.

4.12. **Strain Relief Requirements:** All Strain relief bars shall consist of a metal bar that mounts to the rear of a standard EIA 19-inch rack to support a minimum of 24 cables exiting from the back of a patch panel with a 2-inch to 5-inch inward mounted offset. Cables shall be secured with integrated adjustable clips, hook and loop strips or cable ties. Optional quick release brackets shall provide an easy way to remove the strain relief bar without the use of tools.

NOTE: Vinyl tape will not be accepted

4.13. **Fiber Optic Cabling for Inside Structure Installation:** Inside plant single-mode fiber will have a (YELLOW) Polyvinyl Difluoride jacket and multi-mode will have a (ORANGE) Polyvinyl Difluoride jacket for quick identification unless otherwise noted for specified network. Cable medium and strand count shall be determined by 96 CS Authority Having Jurisdiction and customer requirement(s).

4.14. **Fiber Optic Connectors:** All new installations requiring the installation of a fiber optic distribution panel will use the connector style below:

4.15. **Fiber Optic Connector — LC, SM:** Splice Cassette, 24 fiber strands, LC, UPC, Duplex, Single-Mode (OS2), Single-Fiber (250 µm).

4.16. **Fiber Optic Connector — LC, MM:** Splice Cassette, 24 fiber strands, LC, PC, Duplex, 62.5 µm (OM1), 50 µm (OM 3 and 4).

4.17. **Fiber Optic Patch Panel:** All fiber optic housing units shall be compatible to support fiber splice cassettes mentioned in 4.8.

4.18. **Fiber Optic Core Cables:** Non-Armored MicroCore® Fiber (or equivalent) is to be used for new installations. Due to damages caused by lightning, all fiber optic cables will contain zero conductive materials.

4.19. **MicroCore® Fiber Single-Mode Cable (or equivalent):** Minimum strand count to be installed unless otherwise approved by 96 CS.

4.20. **Maintenance-Holes:** Shall be equipped with all accessories to provide a complete system as or like Oldcastle Precast concreted MH design and meet applicable ASTM standards specification.

4.20.1. Main distribution MH system interior size is 12-feet (length) x 6-feet (width) x 7-feet (height) and shall have a load rating of HS-20 for heavy vehicular traffic.

4.20.2. Sub-distribution MH systems depending on location and project design are pre-cast reinforced concrete interior size 3-feet (width) x 5-feet (length) x 4-feet (height) and shall have a load rating of HS-20 for heavy vehicular traffic.

4.21. **Underground Plant Conduit HDPE:** UL Listed HDPE is a flexible, non-metallic raceway used to protect underground cables. It has superior crush resistance, low coefficient of friction, and high tensile strength. Size, length and type will be determined during design. Smooth wall, approved/listed for directional boring, minimum Schedule 80 HDPE SLR 11.5, ASTM F2160, NEMA TC 7.

4.22. **Underground Plant Conduit Schedule 40/80:** Non-metallic conduits shall be encased in concrete of minimum 3,000 lb/in2 (20,700kPa) compressive strength where vehicular traffic (i.e. automotive, railway) is above the pathway or where a bend or sweep is placed.

Chapter 5

EMERGENCY REPAIR PROCEDURES

5.1**. ISP/OSP Telecommunication Infrastructure Copper/Fiber Repair Guidelines:** Contractor shall notify Eglin's 96 CS Communications Focal Point (CFP) at 850-882-2666 or immediately upon discovery of any damaged Eglin communications cyber infrastructure. Extent of repairs required will be assessed and determined by 96 CS/CC or designated Authority Having Jurisdiction (AHJ).

> **NOTE**: All temporary and/or permanent repairs shall be made at no additional cost to the government. Repairs shall be IAW all applicable industry and local standards.

5.2. **Temporary Repair Actions:** Temporary repairs shall be initiated within 12-hours of reported/identified damage and must restore all circuits (pairs, strands, etc...) to full mission capability within 24-hours unless otherwise approved by AHJ. Contractor shall provide 24 hour/7 day a week on-call maintenance service for temporary repairs until all permanent repairs have been completed and accepted by the AHJ.

5.3. **Permanent Repair Actions:** All fiber optic and copper communications cyber infrastructure shall be restored to its original state or better prior to damage for all permanent repairs. All damaged communications cyber infrastructure shall be replaced, at a minimum, to the closest, pre-existing, splice/terminal locations regardless of distance and/or cost incurred. New or additional splices shall not be allowed for permanent repairs without written approval from the designated AHJ.

5.3.1. Contractors shall provide a Statement of Work (SOW), test plan and product submittals for all proposed permanent repair solutions within 5 business days from date of reported damage to 96 CS/CFP and AHJ for written approval prior to beginning any permanent repairs.

Chapter 6

TELECOMMUNICATIONS CONTRACTOR(S) QUALIFICATIONS

6.1. Telecommunications Contractor(s) Qualifications Requirements

6.1.1. Work under communications requirements shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: The Telecommunications System Contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the Telecommunications Contractor and of the key personnel.

6.1.2. Telecommunications Contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications fiber optic and copper OSP/ISP systems and equipment. The Telecommunications Contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the Telecommunications Contractor.

6.1.3. Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications fiber optic and copper OSP/ISP systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

6.1.4. Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel. In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3-years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications

6.1.5. Indicate that all key persons are currently employed by the Telecommunications Contractor or have a commitment to the Telecommunications Contractor to work on this Project. All key persons shall be employed by the Telecommunications Contractor at the date of issuance of this solicitation, or if not, have a commitment to the Telecommunications Contractor to work on this Project by the date that the bid was due to the Contracting Officer.

NOTE: Only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this Contract, as they functioned in the offered successful experience. Any substitutions for the Telecommunications Contractor's key personnel requires approval from the Contracting Officer.

NOTE: The term approved is defined in this document and other standards as acceptable to the authority having jurisdiction.

Chapter 7

CRITICAL EDGE BUILDING

7.1. **Classification and Criteria**

7.1.1. Specific criteria shall be met in order for a facility to be classified as a critical edge building (CEB) on Eglin AFB. Discussions to classify a facility as a CEB will take place during the design kickoff, charrette, or SATAF meetings. If the organization wishes to seek the CEB classification, customer shall complete the Critical Edge Building Classification and Criteria template coordinated by 96 CS/SCOI. Responses to the specified criteria will dictate an approved/disapproved CEB classification. In accordance with current Air Force Base Area Network Specifications (AFBAN) policy, a facility shall be classified as a CEB prior to implementing redundant links to two different Information Transfer Buildings (ITBs) or Core Nodes. If the mission set changes throughout the lifecycle of the facility, customers shall reassess their responses to the criteria to ensure the justification for being a CEB is still warranted. Additionally, if a facility meets compliance to be classified as a CEB, the alternate fiber path shall be physically diverse. If all means necessary have been exhausted to ensure physically diverse fiber paths have been implemented, but physical diversity is still unachievable, logically diverse cable paths are an exception, but are not guaranteed. Physically diverse fiber paths shall be classified as the following: Fiber Point of Entry to the facility for alternate route should be different from primary point of entry, but same point of entry is also authorized up to 50-feet maximum. Then both FOCA's are required to be in separate ducts using different communication pathways in different geographical directions. See current AFBAN for additional pathway information.

7.1.2. Once approval for the classification and criteria document has been completed, the 96 CS network engineers will conduct extensive network assessments to determine the most viable core node infrastructure capable of supporting the customer’s new CEB requirement. Following network assessment completion for each core node where logical path and ITB has been determined, the physical path and duct assessment will be conducted by the 96 CS Cyber Infrastructure personnel.

Chapter 8

COMMUNICATIONS EQUIPMENT LOCATION (CEL)

8.1. Eglin AFB CEL Requirements

8.1.1. CEL's must be locked and secured IAW DoD 5200.08-R, paragraph C6.2.4.

8.1.2. CEL's must be clean and in good order IAW AFMAN 91-203, paragraph 30.1.

8.1.3. CEL's cannot be used as a storage room and must only contain 96 CS information technology equipment IAW UFC 3-580-01, paragraph 2-4.2.1.

8.2. 96 CS managed CEL's house installation network equipment and shall be protected IAW Defense Information Systems Agency (DISA) Traditional Security Guidance.

8.3. Access to CEL's or cohabiting space within a CEL shall only be provided as a last resort.

8.3.1. Cohabiting space within a CEL should only be requested if there is absolutely no other suitable space within the facility to house non-core networking equipment. Valid justification is required and must be accompanied by documentation preventing units from installing non-core equipment elsewhere within the facility.

8.3.2. If a CEL shall be deemed a cohabiting space, specific criteria must be met to retrofit an existing CEL:

- If existing keying mechanism is standard Z5 key lock, then entire door handle and lock mechanism shall be replaced to support cipher lock and Z5 lock keying mechanisms. Cohabiting unit shall use cipher lock for entry and 96 CS will use standard Z5 lock keying mechanism.
- A survey shall be conducted by 796 CES in coordination with 96 CS to assess electrical loads and heating/ventilation air conditioning (HVAC) requirements for proposed unit equipment.
- The requesting unit shall submit a request to 796 CES when current or existing electrical loads and or HVAC loads will be exceeded or limitations to existing provisions will not support user's requirement.
- The requesting unit shall fund for any expansions to electrical, HVAC, door handle retrofits, etc. to satisfy unit's requirement.

8.4. Units requesting space for equipment installation in a CEL shall adhere to all DoD policies and regulations, to include but not limited to:

Air Force Base Area Network Functional Specifications (AFBAN)
DISA Security Technical Implementation Guides (STIGs)
Unified Facilities Criteria (UFC) 3-580-01, Telecommunications Interior Infrastructure Planning and Design
DoD 5200.08.R, Physical Security Program
AFMAN 91-203, Air Force Occupational Safety, Fire, and Health Standards

T.O. 00-33A-1001, General Cyberspace Support Activities Management Procedures and Practice Requirements
AFI 33-200, Air Force Cybersecurity Program Management

8.5. All 96 CS core network equipment shall reside in its own separate lockable enclosure. All non-core network equipment shall reside in a separate enclosure from 96 CS network equipment.

8.5.1. Core network equipment includes: all NIPRNet, SIPRNet, VoIP, and SONET-Transport equipment managed by the 96 CS.

8.5.2. A lockable enclosure is defined as either a lockable equipment rack or lockable wall mount cabinet that is controlled and accessed by 96 CS authorized personnel only. 96 CS lockable enclosures are outlined in Attachment D.

8.6. All network connections must be secured within a locked communications closet or secured within a CEL if room is accessed by non-network personnel.

8.7. Outside Plant cabling infrastructure shall only reside in designated 96 CS lockable enclosures.

8.8. 96 CS managed patch panels and premise wiring shall not be cross utilized with other unit services.

8.9. The final approver for 96 CS CEL usage or cohabiting space within a CEL is the 96 CS/CC.

8.9.1. CEL access requests shall use the 96 CS Communications Focal Point (CFP) Remedy process.

8.9.2. 96 CS personnel shall change the cipher lock code when personnel on the access roster change or when CEL access privileges have been revoked.

8.10. 96 CS shall provide a tech solution in collaboration with 796 CES for all CEL usage requests. CEL usage is not guaranteed and is subject to 96 CS/CC approval.

8.11. CEL building manager shall submit names of personnel requiring CEL access to their unit's security manager for vetting. Unescorted access shall only be granted to personnel with a minimally favorable adjudicated National Agency Check (NAC), appropriate security clearance, and a need-to-know IAW the DISA Traditional Security STIG. Vetted access lists names shall be approved and signed by the submitting unit's commander or appointed representative.

8.11.1. Approved access list personnel shall be provided cipher lock codes for CEL access, but codes may not be shared with other unit members.

8.11.2. When unit member access for cohabiting space is no longer required or personnel no longer require access to the shared space, units shall remove names from the access list and submit updates to the 96 CS.

8.11.3. Units shall audit their access lists every six months IAW the DISA Traditional Security STIG. The unit security managers, facility managers, and work center SMEs shall revalidate each unit's access list.

8.11.4. CEL Inspection

8.11.4.1. 96 CS Policy and Evaluation (96 CS/SCQ) are the lead inspectors for 96 CS managed CELs.

8.11.4.2. Inspection results shall be sent to the associated units for further actions.

8.11.4.3. Any unit in breach of the CEL guidance shall be considered for removal from the 96 CS CEL

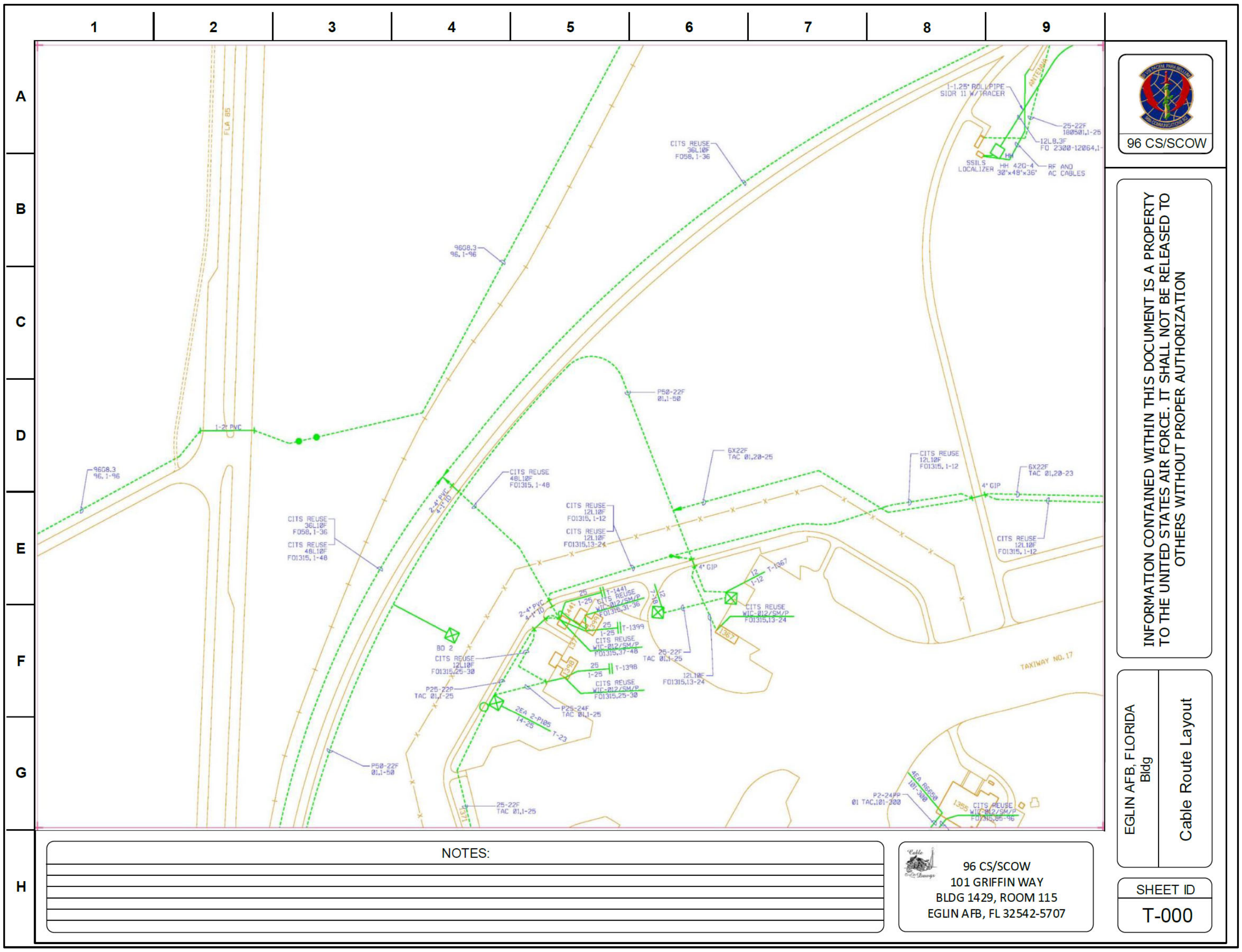
8.12. Any new building projects or facility renovations shall adhere to this guidance and be incorporated into the standard architecture.

Attachment A

DRAWING SPECIFICATIONS

A.1. Cable Route: The outside plant communications cable shall be depicted as installed, showing street/road locations and names, building 'footprints' accurately oriented as actually located. Maintenance Holes shall be depicted accurately oriented as located in reference to buildings and streets/roads. Extraneous information of other utility disciplines shall NOT be accepted on the as-built drawings. The information on the as-built drawings shall pertain to COMM specific.

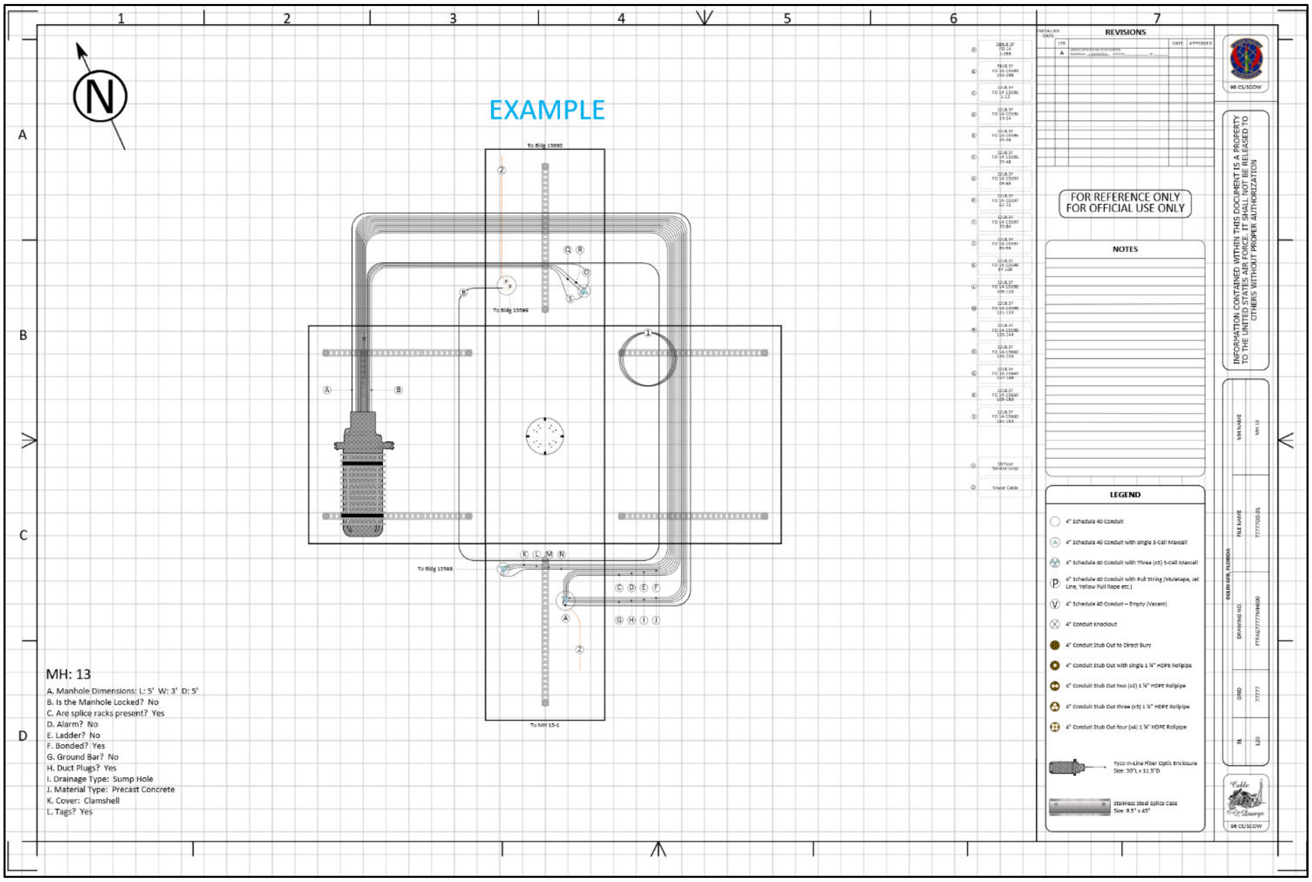
A.2.



Sample Cable Route Drawing

A.3. Butterfly: Drawing of the interior of individual Maintenance Holes that were installed, passed through, or modified in any way. Reference drawing below.

A.4. The Installer shall augment the GNSS survey by using conventional land surveying equipment and electronic cable locating (underground utility toning) equipment to meet requirements. The Installer shall ensure collected/provided data is compatible with the CVC. The accuracy of the GNSS points shall be no more than 6-12-inches after differential correction/post-processing.



Example: Maintenance Hole Butterfly with GIS Metadata

A.5. Geographic Information Systems (GIS) data: Provide technical/field services necessary to locate and perform Geographic Information System (GIS) data collection of Outside Plant (OSP) cable infrastructure and communications pathways for government entry into the Cyberspace Infrastructure Planning System (CIPS) Visualization Component (CVC). Additionally, the Contractor shall enter into all communication "containers" to include communication Maintenance Vaults, Maintenance-Holes (MH), and Pedestals in order to record/document detailed container information by means of field drawings. Outside plant features/containers include vaults, maintenance-holes, pedestals, underground cables, direct buried splices, terminals, etc. The communications pathways include duct routes, aerial and direct-buried cable, trench routes, communication pathway entry points on building exterior walls that lead to interior building entry terminals, etc. The Installer shall augment the GPS survey by using conventional land surveying equipment and electronic cable locating (underground utility toning) equipment to meet requirements. The Installer shall ensure collected/provided data is compatible with the CVC. The accuracy of the GPS points shall be no more than 6-12-inches after differential correction/post-processing.

NOTE: Contractor/Installer(s) shall coordinate with the AHJ through a Request for Information (RFI) to ensure they have the latest data dictionary before accomplishing any project GIS actions.

Shapefile filename extensions:
.prj. = projection description, using a well-known text representation of coordinate reference systems
.dbf = attribute format; columnar attributes for each shape, in dBase IV format
.shp = shape format; the feature geometry itself
.shx = shape index format; a positional index of the feature geometry to allow seeking forwards and backwards quickly
.cor = COR files generated by GPS Pathfinder Office after post processing the positions captured by GPS devices

A.6. GPS_MAINTENANCE HOLE

A.6.1. Definition: An enclosed structure MHs. A butterfly layout is used that shows the floor and walls flattened out so that duct openings can be drawn on the walls. This must be represented as one polygon (one row in the table). The point is used to show the center of the MHs cover.

A.6.2. Geometry type: Site (Point).

A.6.3. Attributes:

Column Name	SDSFIE Common Name	Description	Data Type	Use	Domain Table
MH_NAME	Identifier Name	The standard identifier name (e.g., MH-19)	Char (60)	Required	
MATERIAL		Used to describe the material composition of the maintenance hole	Menu	Required	PreCast Concrete Fiberglass Quazite Unknown Other
SIZE	Dimension of the structure	The width, length, and height (or depth) of the structure measured from the inside	Char (30)	Required	

Column Name	SDSFIE Common Name	Description	Data Type	Use	Domain Table
LID		Shape of the structure lid	Menu	Required	Round Clamshell Rectangle Other
DRAINAGE_TYPE			Menu	Required	Sump Hole Seepage Pit Other None
SPLICE_RACK		Support braces on the side of the structure	Menu	Required	Yes No
LOCK_PRESENT		Is the structure able to be locked	Menu	Required	Yes No
SPLICE_PRESENT		Type of splice case is in the structure	Menu	Required	Copper Fiber Optics Both None
BONDED			Menu		Yes No
GROUND BAR			Menu		Yes No
ARE DUCTS PLUGGED			Menu		All Some None

A.7. COMM_PATH_SEGMENT

A.7.1. Definition: Link that represents an enclosure path of comm, items outside of a building, maintenance hole, General Container, or other enclosed structure. For duct banks, comm-path segment can represent the virtual path, duct bank, duct, and innerducts. For ducts, comm-path segment can represent the virtual path, duct, and innerducts. For direct-buried cables at road-crossings, comm- path segment can represent the virtual path, road-crossing duct, and direct-buried cables. It can also represent the path of aerial cable, cable-bridges, and cable-troughs.

A.7.2. Geometry type: Polyline

A.7.3. Attributes:

Column Name	SDSFIE Common Name	Description	Data Type	Use	Domain Table
FROM		Origination	Char (60)	Required	
TO		Destination	Char (60)	Required	
CABLE_ID		A field that describes the originating and end structure this segment is representing	Char (60)	Required	
INSTALL_TYPE		Type of path	Menu	Required	Duct Duct Bank Direct Buried
NUMBER_OF_DUCTS		Condition, Install Type = Duct Bank	Numeric Min=1 Max=20 Default=1		
DUCT_SIZE		Dimension of the duct measured in inches	Numeric Min=1 Max=12 Default=4	Required	
MATERIAL		Composition of the Duct		Required	Schedule 40 PVC Schedule 80 PVC HDPE
DEPTH		The minimum depth of this part of the path from grade, in inches	Numeric	Required	
COMMENTS					

A.8. PEDESTAL

A.8.1. Definition: An above ground container used as a splice point, testing point, ortermination.

A.8.2. Geometry type: Site (Point).

A.8.3. Attributes:

Column Name	Description	Data Type	Use	Domain Table
TERMINAL_ID	A unique container identifier	Char (60)	Required	
SIZE	Dimensions of the container	Menu	Required	BD1 = 2"x2" BD2 = 4"x4" BD3 = 6"x6" BD4 = 8"x8" BD5 = 10"x10" BD7 = Cabinet – 23"x12" BD8 = Cabinet – 32"x18"
GROUNDED/BONDED		Menu	Required	Yes No
BONDING_SECURED		Menu	Required	Yes No Some
TERMINAL		Menu	Required	Yes No
MATERIAL		Menu	Required	Metal Fiberglass
CABLE TAGS PRESENT		Menu	Required	Yes No Some
COMMENTS		Char (230)		

A.9. MARKER POLE

A.9.1. Definition: An above ground marker used to identify MH or Cable Route.

A.9.2. Geometry type: Site (Point).

A.9.3. Attributes:

Column Name	Description	Data Type	Use	Domain Table
LOCATION		Char (60)	Required	
TYPE	What the marker is used for	Menu	Required	MH/HH Marker Cable Route

A.10. MARKER BALL

A.10.1. Definition: A below ground marker used to identify entrances, road crossings, routes, stub out locations.

A.10.2. Geometry type: Site (Point).

A.10.3. Attributes:

Column Name	Description	Data Type	Use	Domain Table
TYPE	What the marker is used for	Char (60)	Required	Ball Disk
MARKER PURPOSE		Menu	Required	Splice Bldg Entrance Road Crossing Cable/Duct Route MH Stub out
MANUFACTURER		Char (60)	Required	

A.11. SPLICE

A.11.1. Definition: A below ground splice used to connect cables or tracing wire.

A.11.2. Geometry type: Site (Point).

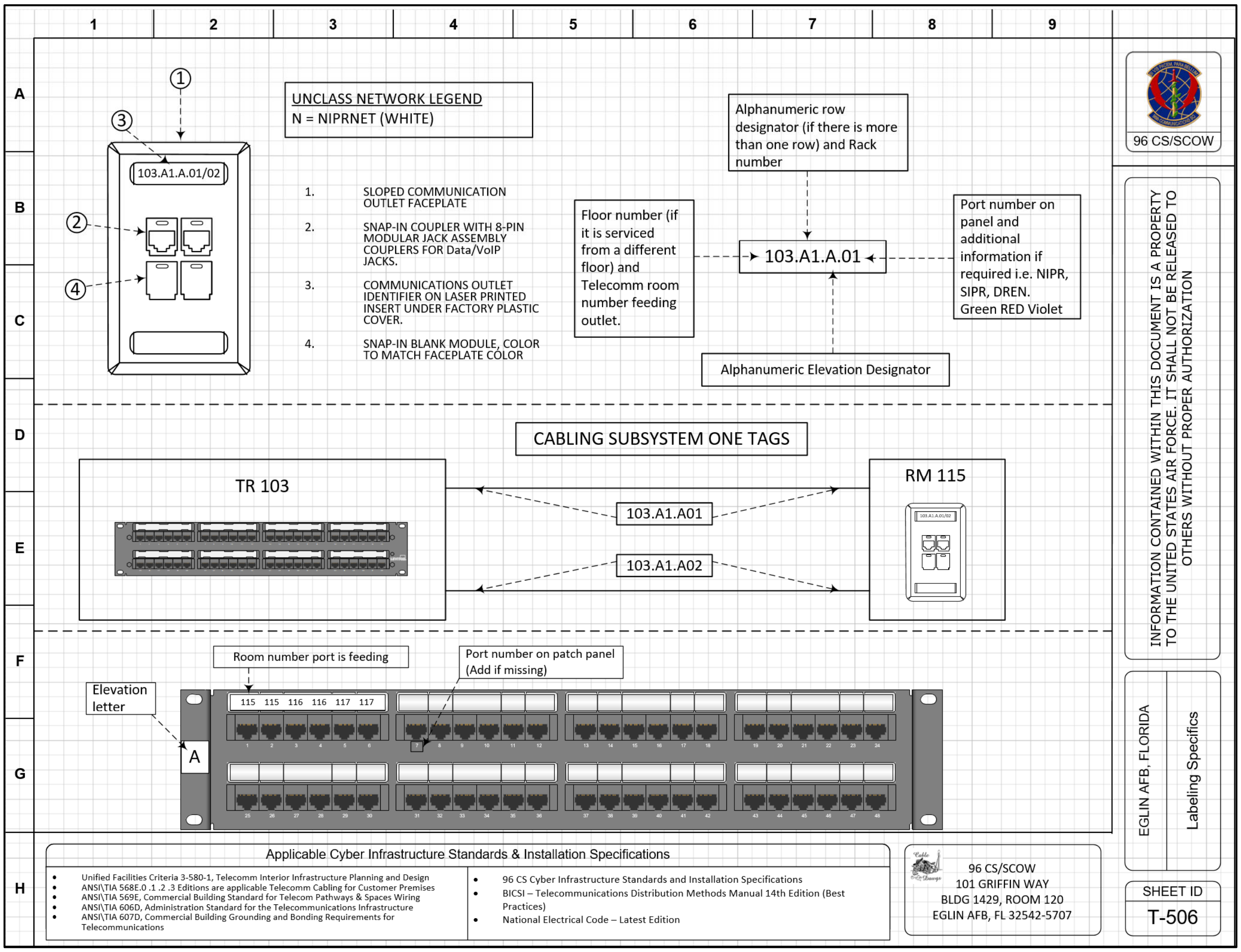
A.11.3. Attributes:

Column Name	Description	Data Type	Use	Domain Table
LOCACTION	Where the splice is	Char (200)	Required	
TYPE	What type of splice	Menu	Required	Auto-Wire Trace Safe Copper Fiber Optic

Attachment B

LABELING SPECIFICATIONS

B.1. LABELING SPECIFICATIONS



Attachment C

FIBER DESIGN REQUIREMENTS

C.1. FIBER DESIGN NOTES

Eglin AFB Core Fiber Optic Baseline

References: (a) AF Base Area Network Functional Specification (AFBAN), dated February 2021

C.1.1. Per the AF Base Area Network Functional Specification (AFBAN), dated February 2021, section 4.1.3.

- New ITB construction shall contain a minimum of 72 single-mode (OS1 and OS2) fiber strand cables, one each Home Run to separate existing (or new) ITBs. Higher strand counts may be used based on known and future requirements.
- Existing ITB-to-ITB cable with less than 18 available strands is a candidate for additional fiber cables between the ITBs.
- Additional fiber cables installed between existing ITBs shall contain a minimum of 48 single-mode (OS1 and OS2) fiber strands. Higher strand counts may be used based on known and future requirements.
- New EB construction shall contain a minimum of 12 single-mode fiber strands dedicated between that EB and its ITB. Higher strand counts may be used based on known and future requirements.
- Existing EB-to-ITB cables with 4 or less available strands is a candidate for additional fiber between the EB and the ITB.
- Additional fiber cables installed between existing EBs and ITBs shall contain a minimum of 12 single-mode (OS1 or OS2) fiber strands. Higher strand counts may be used based on known and future requirements.
- With any cable installation, 10% of the total fiber strands (rounded to the nearest pair of fibers) should be unused to provide emergency routing should the need arise.

Home Run cable design is the recommended method of fiber distribution when adequate OSP pathway is available. In order to conserve preinstalled available pathways, fiber optic trunk design should be considered if ITB to EB fiber routes must traverse existing available pathway routes that are near capacity.

NOTE: The above standards cover minimum OSP fiber optic requirements needed to provide minimal connectivity and required spare fiber for maintenance purposes only.

C.1.2. The organizational requirements supporting advanced warfighter missions and the demand for increased fiber optic capabilities to support “gray” or “other” networks, Intrusion Detection Systems (IDS), high resolution video graphics imaging and global environmental management control systems has increased. To ensure these requirements and all core services are satisfied and IAW the AFENT architecture specifications and Assured Services LAN (ASLAN), Eglin’s minimum fiber requirements have been determined to be the following:

a) Information Transfer Building to Edge Building = 24 Single Mode fiber optic strands

b) Edge Building main telecommunication room to other downstream communication equipment locations within the same building = 24 Single Mode fiber optic strands

c) Fiber Optic strands 1-18 shall be recorded in the circuit actions installation reporting system as reserved for 96 CS management/use to support and maintain base core services only.

d) Fiber optic strands 19-24 will be available to satisfy design requirements like Intrusion Detection System (IDS) "Alarms" and/or other temporary mission support requirements. All additional fiber optic strand requirements for customer specific use that will deplete or diminish the core service reservations shall be in addition to the baseline 24 strands to include additional maintenance spare fiber optic strands. Final fiber optic cable sizing shall be determined by 96 CS during network design and project requirement reviews.

C.1.3. Cable replacement will be the first design consideration for installation requirements of new cable to existing EBs or through legacy underground plant infrastructure with limited duct availability.

C.1.4. All network designs will be IAW the most current AFBAN, applicable Unified Facilities Criteria, applicable industry standards, and local specifications. (See attachment G - Applicable Publications)

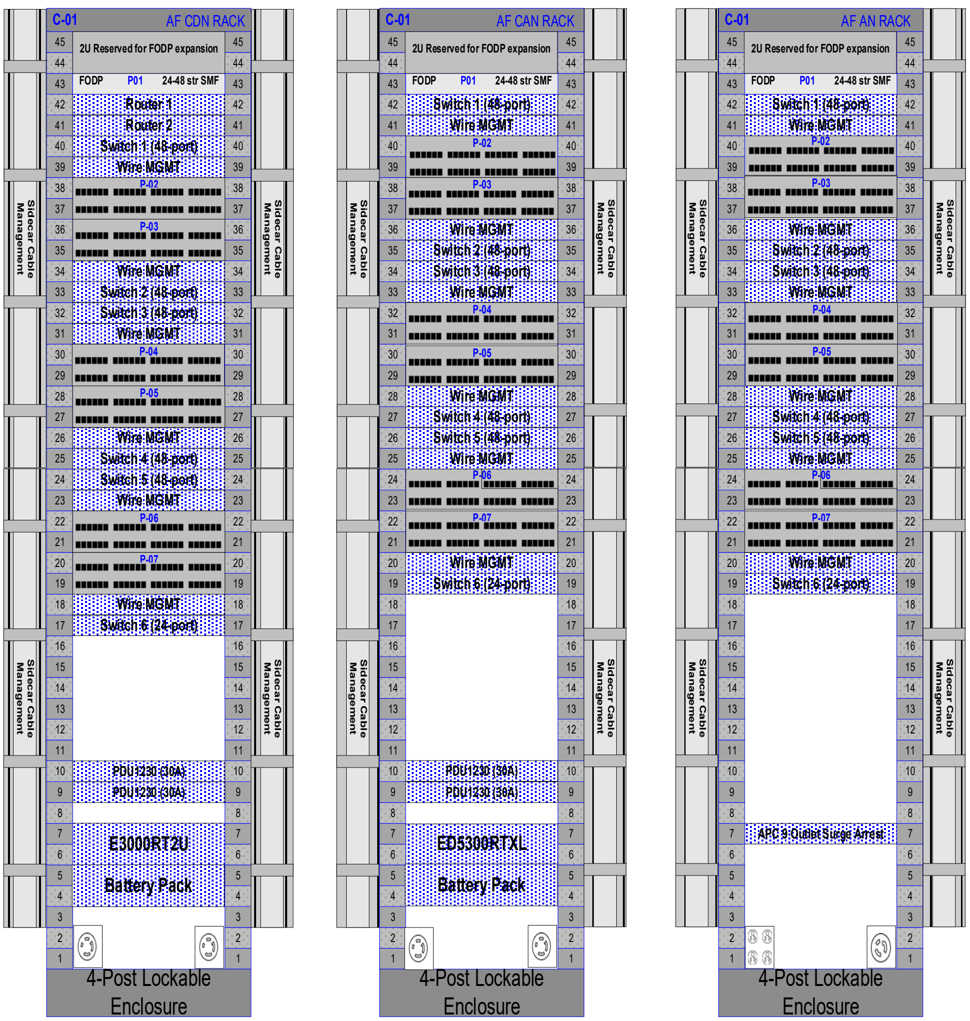
Attachment D

RACK ELEVATION STANDARDS FOR NIPR/SIPR/DATA/VOIP

D.1. FLOOR-MOUNT LOCKABLE NETWORK ENCLOSURE

Standard AF Data/VoIP Rack Elevation for all NIPR TRs

Current as of: 27 Jul 22



AF CDN RACK AF CAN RACK AF AN RACK

Notes:

1. All 72" TR racks shall be 4-post lockable enclosures with vertical sidecar cable management to support wiring on either side.

2. All 72" TR racks shall follow this elevation layout to comply with Eglin rack elevation standards.

3. All 4-post lockable enclosures shall be specified by 96CS to ensure proper rack specifications based on customer provided requirements. Racks shall be lockable enclosures with part number GL790ES-2442MS or equivalent.

4. Dedicated circuits with power receptacles indicated below and depicted in the rack elevation shall be supplied by onsite contractor. Exact power receptacle shall be identified in the 100% design drawings based on the requirements.

5. A dedicated junction box shall be placed no greater than 2-feet from the 96CS lockable enclosure and appropriate electrical wiring shall be homerun from supporting electrical panel to junction box. A pigtail splice with compatible size wiring shall be run from the 96CS electrical outlet(s) to the junction box and interconnected with dedicated homerun wiring using appropriate wire nuts.

6. No other circuits shall reside in this junction box to ensure survivability of the 96CS dedicated circuits are not interrupted or impacted.

7. Each rack shall require 1-foot patch cables routed from each patch panel to its corresponding network switch. All network equipment to provide LAN connectivity is specified by 96CS and funded by the contractor or the occupying customer.
   5A: Example RU40 patches to P-02 and RU33 patches to P-03, etc…

8. PDU's shall always be 1U higher than the top mounted UPS.

120V / 20A dedicated circuit w/Quad receptacle mounted at base of rack w/receptacles facing towards rear of rack

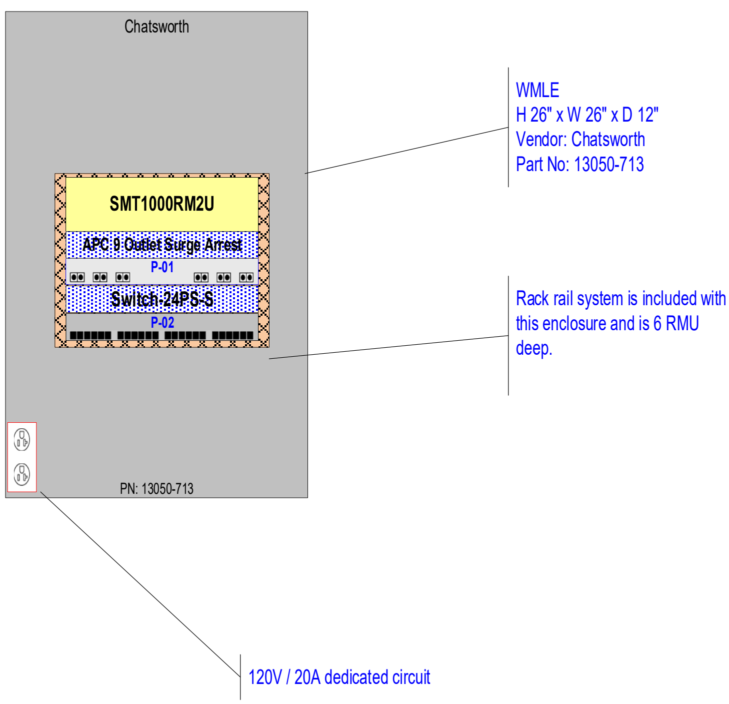
120V / 30A dedicated circuit w/NEMA L5-30R w/ Duplex receptacle mounted at base of rack w/receptacle facing towards rear of rack

208V / 30A dedicated circuit w/NEMA L14-30R receptacle mounted at base of rack w/receptacle facing towards rear of rack

D.2. WALL-MOUNT LOCKABLE NETWORK ENCLOSURE (VERTICAL EQUIPMENT MOUNT)

Standard AF Data Wall-Mount Lockable Enclosure (WMLE)
Rack Elevation for all 96 TRs using a Chatsworth WMLE

Current as of: 27 Jul 22



Notes:

1. WMLE will be mounted on backer board in TR. All AF network equipment will be mounted vertically in the WLME.

2. A 120V / 20A dedicated electrical circuit will be mounted inside the wall mount enclosure as depicted in the diagram to the left.

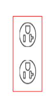
3. A dedicated junction box shall be placed no greater than 2-feet from the 96CS lockable enclosure and appropriate electrical wiring shall be homerun from supporting electrical panel to junction box. A pigtail splice with compatible size wiring shall be run from the 96CS electrical outlet(s) to the junction box and interconnected with dedicated homerun wiring using appropriate wire nuts.

4. No other circuits shall reside in this junction box to ensure survivability of the 96CS dedicated circuits are not interrupted or impacted.

5. Rack elevation shown here is top-view depiction with UPS closest to backer board.

6. Fiber optic PP and TP PP will also be terminated in this enclosure.

7. Each rack shall require 1-foot patch cables routed from patch panel to the corresponding network switch. All network equipment to provide LAN connectivity is specified by 96CS and funded by the contractor or the occupying customer.

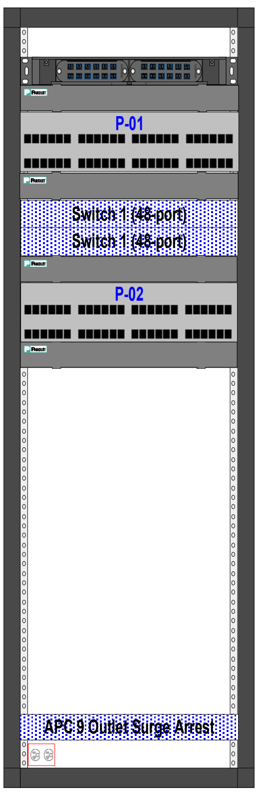


120V / 20A dedicated circuit w/ duplex receptacle mounted inside enclosure.

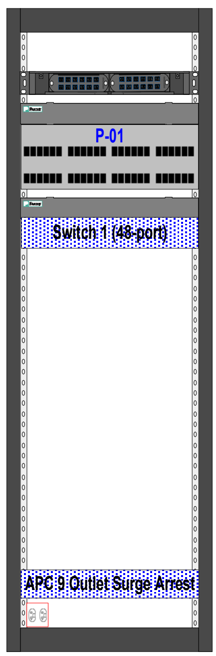
D.3. WALL-MOUNT LOCKABLE NETWORK ENCLOSURE (HORIZONTAL EQUIPMENT MOUNT)

Standard AF Data Wall-Mount Lockable Enclosure (WMLE)
Elevations for all 96CS TRs using Hoffman WMLE's

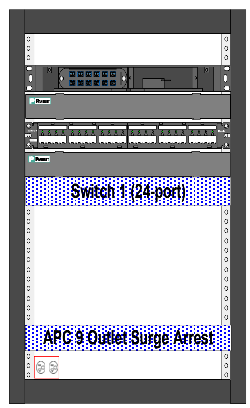
Current as of: 27 Jul 22



EWMS482425
48.03 x 23.62 x 25.09 1220 x 600 x 637 26
EWMR48T or EWMR48S



EWMS362425
36.02 x 23.62 x 25.09 915 x 600 x 637 19
EWMR36T or EWMR36S



EWMS242425
23.62 x 23.62 x 25.09
EWMR24T or EWMR24S

Notes:

1. WMLE shall be mounted on backer board in TR. All AF network equipment shall be mounted vertically in WMLE.

2. A 120V / 20A dedicated circuit shall be mounted inside WMLE toward the bottom facing the front. Preferably on either side inside the WMLE.

3. Rack elevation shown here is front-view depiction. If UPS is required, it will be placed at the bottom of the WMLE above the electrical receptacle , but 1U below the surge arrestor.

4. A dedicated junction box shall be placed no greater than 2-feet from the 96CS lockable enclosure and appropriate electrical wiring shall be homerun from supporting electrical panel to junction box. A pigtail splice with compatible size wiring shall be run from the 96CS electrical outlet(s) to the junction box and interconnected with dedicated homerun wiring using appropriate wire nuts.

5. No other circuits shall reside in this junction box to ensure survivability of the 96CS dedicated circuits are not interrupted or impacted.

6. Each rack shall require 1-foot patch cables routed from each patch panel to its corresponding network switch. All network equipment to provide LAN connectivity is specified by 96CS and funded by the contractor or the occupying customer.

7. All 96CS fiber optic PPs and TP PPs shall also be terminated inside the WMLE.

8. All WMLE's shall be double-hinged with a solid metal front door.

9. All keys to WMLE's shall be turned over to the 96CS upon installation.

10. All WMLE's shall be sized to support 20% growth.

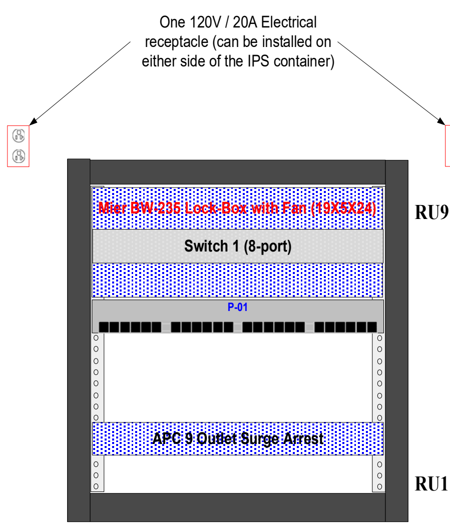
11. All WMLE's shall be grounded IAW UFC 3-580-01.

120V / 20A dedicated circuit w/duplex receptacle mounted inside enclosure.

D.4. IPS CONTAINER

Standard AF Data IPS Container
Rack Elevation for 96CS IPS Container

Current as of: 27 Jul 22



Hamilton Class 5 Single Door Model 23-36-19

Notes:

1. IPS container shall be installed in End-User-Area and not in 96CS TR.

2. All AFNET related 96CS network equipment shall be mounted IAW the diagram to the left.

3. 96CS Network switch shall be housed in IPS container inside Mier Box BW-B235 and placed at RU 7-9.

4. A 120V / 20A dedicated circuit shall be mounted outside located at the top left or right of the IPS container, but no further than 1-foot away.

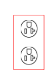
5. Rack elevation shown here is front-view depiction.

6. All network equipment to provide LAN connectivity is specified by 96CS and funded by the occupying customer.

7. All IPS containers shall be Class 5 with single door.

8. All IPS containers shall meet proper clearances from the wall in order to circulate room air through the cabinet for electronic equipment cooling.

9. All IPS containers shall be grounded IAW UFC 3-580-01.



120V / 20A dedicated circuit w/duplex receptacle mounted inside enclosure.

Attachment E

CABLE MANAGEMENT ACCESSORIES

E.1. Cable Management.

BGS-79 – Brush grommet to cover rear vertical cable pass through
ESC-K12 – Cable management rail kit for front or rear rails; includes 12 sections of "fingers" (each section 7 RMU); rails will need to be recessed 4.5"
GL790ES-2242MS - Great Lakes 79" x 24" x 42" D Complete Rack Mount Enclosure, Black
SC67942 - Great Lakes External Cable Manager/Sidecar
SCP7942 Great Lakes Side Car End Panel
VCT-79 – Vertical cable trough
VCT-79C – Cover for VCT-79
VCB-7936 – Vertical cable bar kit (includes 1 vertical cable bar, 2 horizontal bars and 6-inch straps); use with optional ¼ turn "D" rings
CM-26 – Kit of 10, ¼ turn "D" rings, 3.5"x 5"

E.2. Other Accessories.

HDW-105-50 **–** Package of 50 M6 cage nuts with screws (12mm screw length)

Attachment F

SECURITY TECHNICAL IMPLEMENTATION GUIDE

F.1. PHYSICAL SECURITY

Based on the AFI 31-101 section 2.7.1.3 all locations where active communications equipment is used are designed as Protection Level 4 (PL) and have to be secured as such.

Every data switch in the network shall reside in a physically locked CEL closet, data center, or a lockable enclosure. Controlled areas are legally defined areas containing PL4 resources. Only authorized personnel, designated by a unit commander, have access to controlled areas.

The designation "controlled area" carries the same legal and moral restrictions as a physical barrier. Unless physical barriers are specifically required, the actual effectiveness of a controlled area may depend entirely on the security awareness of the people working in it. Installation commanders must designate areas containing the resources identified below.

APPLICABLE AFI REFERENCES

AFI 31-101, Section 2.7.1.3. - Mission essential communications facilities and computer centers, RAPCONs to include off installation navigational aids and related resources, control towers, power plants, and environmental control systems critical to operational capability.

The protection implemented shall be sufficient to protect the network from unauthorized personnel. The keys to the locked cabinets and dedicated communications rooms shall be controlled and only provided to authorized individuals appointed by 96 CS leadership.

APPLICABLE STIG REFERENCES

CAT III: NET0140 - The IAO/NSO will ensure the connection between the CSU/DSU and the local exchange carriers (LEC) data service jack (i.e., demarc) is in a secured environment.
CAT II: NET0210 - The IAO/NSO will ensure that all network devices (i.e., IDS, routers, RAS, NAS, firewalls, etc.) are located in a secure room with limited access.
CAT II: NET1730 - The IAO/NSO will ensure that the management workstation (NMS) is located in a secure environment.
CAT II: NET1832 - The ISSM will ensure the VPN tunnel demarcation is located in facilities authorized to process classified US government information, classified at the Secret Level (for SIPRNet).
CAT II: NET-VLAN-001 - The IAO/NSO will ensure that all switches and associated cross-connects hardware are kept in a secured IDF or an enclosed cabinet that is kept locked.

Attachment G

APPLICABLE PUBLICATIONS

Publications current time of contract or design build award or latest editions of the following publications shall apply and be utilized as applicable for engineering, installations, progress checks, quality controls, and final acceptance quality assurance inspections.

- AF Base Area Network Functional Specification (AFBAN) For Official Use ONLY
- AFI 31-101, The Air Force Resource Protection Program for Official Use ONLY
- AFI 31-501, Personnel Security Program Management
- AFI 33-111, Telephone Systems Management
- AFI-91-203, Consolidated Occupational Safety Instruction and Station Protector Installations
- Air Force Systems Security Instruction 7700, Emission Security
- Air Force Systems Security Instruction 7702, Emission Security Countermeasures Reviews
- Air Force Systems Security Instruction 7703, Communications Security: Protected Distribution Systems (PDS)
- ANSI C2-1997, National Electric Safety Code (NESC)
- ANSI/NEMA WC 66, Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pairs
- ANSI/TIA-526-7, OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
- ANSI/TIA-568-E.0, Generic Telecommunications Cabling for Customer Premises
- ANSI/TIA-568-E.1, Commercial Building Telecommunications Cabling Standard
- ANSI/TIA-568-E.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- ANSI/TIA-568-E.3, Optical Fiber Cabling Components Standard
- ANSI/TIA-568-E, Commercial Building Telecommunications Cabling Standard
- ANSI/TIA-569-D, Commercial Building Standard for Telecom Pathways & Spaces Wiring
- ANSI/TIA-570-A, Residential Telecommunications Cabling Standard
- ANSI/TIA-598, Optical Fiber Cable Color Coding
- ANSI/TIA-604-10, FOCIS 10 Fiber Optic Connector Intermateability Standard - Type LC
- ANSI/TIA-606-D, Administration Standard for the Telecommunications Infrastructure
- ANSI/TIA-607-D, Commercial Building Grounding and Bonding Requirements for Telecommunications
- ANSI/TIA-758, Customer-Owned Outside Plant Telecommunications Cabling Standard

Standards and Installation Specifications

- ANSI/TIA-1152, Requirements for Field Test
- ANSI/TIA 942 B DATA CENTER INFRASTRUCTURE
- ANSI/BICSI 002-2019 Data Center Design and Implementation (Best Practices)
- ASTM C 478, Standard Specification for Precast Reinforced Concrete Maintenance Hole Sections
- ASTM D 709, Laminated Thermosetting Materials
- ASTM C 789, Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
- ASTM C 850, Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 Ft of Cover Subjected to Highway Loadings
- ASTM C 857, Standard Practice for Minimum Structural Design Loading for Underground Precast Utility Structures
- ASTM C 858, Standard Specification for Underground Precast Concrete Utility Structures
- ASTM C 890, Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
- ASTM C 891, Standard Practice for Installation of Underground Precast Concrete Utility Structures
- ASTM C 891.11, Standard Practice for Installation of Underground Precast Concrete Utility Structures
- ASTM C 913, Standard Specification for Precast Concrete Water and Wastewater Structures
- ASTM C 1037, Standard Practice for Inspection of Underground Precast Concrete Utility Structures
- BICSI - Telecommunications Distribution Methods Manual 14th Edition (Best Practices)
- BICSI - Outside Plant Design Reference Manual 6th Edition (Best Practices)
- BICSI's ICT Terminology Handbook Version 2.0
- CFR Title 47, Parts 68, Telecommunications, Federal Communications Commission Connection of terminal equipment to the telephone network
- DODI 5000.2, Part 6, System Safety, Health Hazards, and Environmental Impact
- ECA EIA/ECA 310, Cabinets, Racks, Panels, and Associated Equipment
- EPA CFR 40, Parts 1500-1508, Protection of Environment, Council on Environment Quality
- EPA CFR 40, Parts 260, 261, 262, 263, 264, 265, Hazardous Waste Generation and Transportation
- EPS-98-38EITS-001, Equipment Performance Specification for Maintenance and Operations Services for Base Telecommunications System
- FCC Part 68, Connection of Terminal Equipment to the Telephone Network (47 CFR 68)
- ICEA S-83-596, Indoor Optical Fiber Cables
- IEEE 100, The Authoritative Dictionary of IEEE Standards Terms

- MIL-STD-188-124B, Grounding, Bonding, and Shielding for Common/ Long Haul/ Tactical Systems Including Ground Based Communications-Electronics Facilities and Equipment

Standards and Installation Specifications

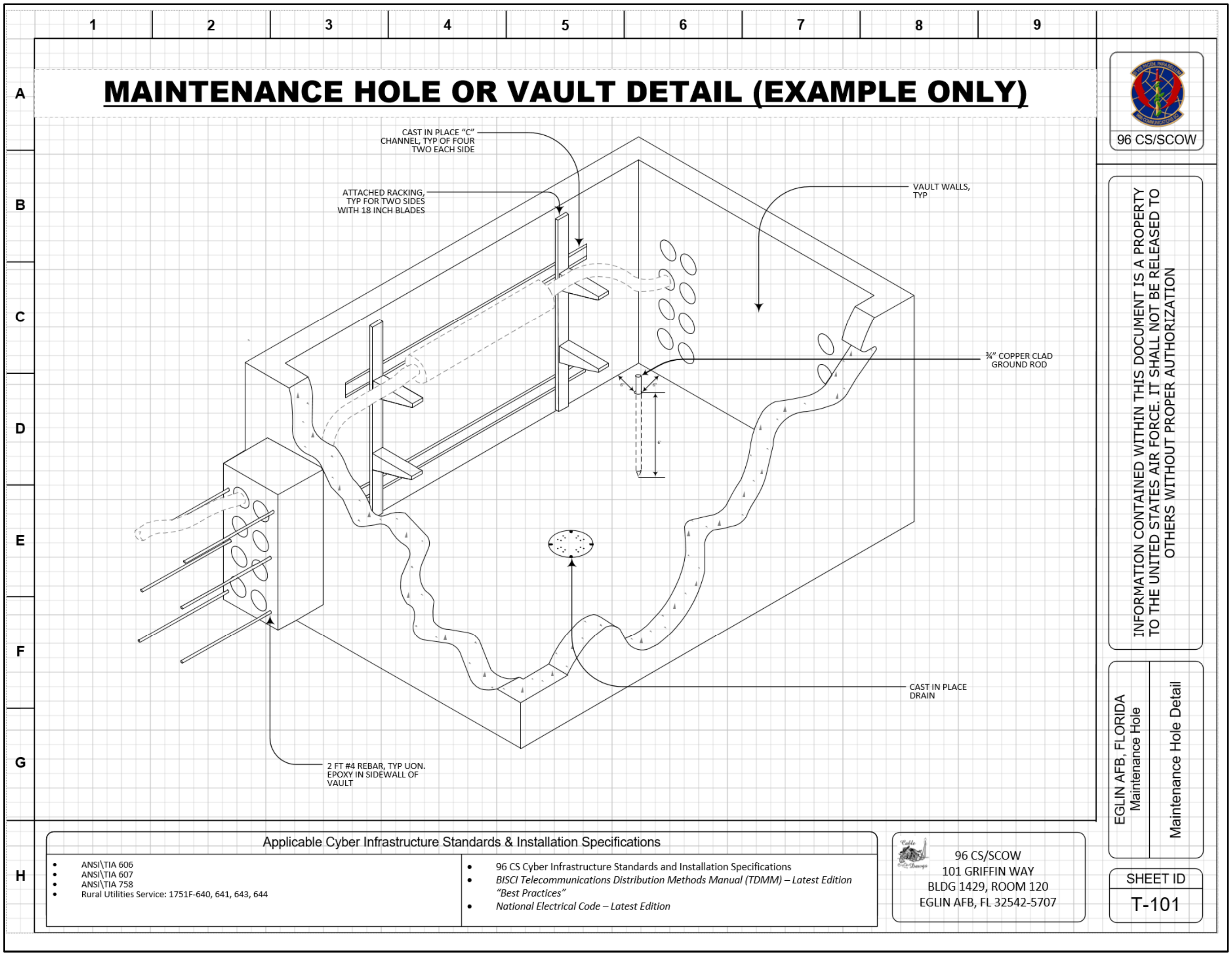
- MIL-STD-882-D, System Safety Program
- NECA/FOA 301-2016 Standard for Installing and Testing Fiber Optics
- NECA/BICSI 568, Standard for Installing Building Telecommunications Cabling
- NECA/NEMA 605-201X Standard for Installing Underground Nonmetallic Utility Duct
- NEMA Standards Publication TC-7
- NEMA Standards Publication TC-2
- NFPA 70, National Electrical Code
- NFPA 70-2002, National Electrical Code (NEC)
- OSHA CFR 29, Asbestos
- OSHA CFR 29, Excavation
- OSHA CFR 29, Hazardous Waste Operation and Emergency Response
- OSHA CFR 29, Occupational Safety and Health Standards
- OSHA CFR 29, Part 1910.1200, Hazard Communications
- OSHA CFR 29, Part 1910.147, The Control of Hazardous energy (Lockout/Tagout)
- OSHA CFR 29, Permit-required Confined Spaces
- OSHA CFR 29, Telecommunications
- REA Standard PC-5A, Bulletin 345-52, REA Standard for Service Entrance
- REA TE & CM Section 451.2, Shield Continuity
- REA TE & CM Section 644, Design and Construction of Underground Cable (Physical Plant)
- REA TE & CM Section 823, Electrical Protection by Use of Gas Tube Arresters
- REA TE & CM, Section 643, Underground Conduit and Maintenance hole Design and Construction
- REA TE & CM, Section 810, Electrical Protection of Electronic Analog Section Digital Central Office Equipment
- REA TE & CM, Section 825, Situations Requiring Special Protection
- RUS Bulletin 1751F-630, Design of Aerial Plant
- RUS Bulletin 1751F-640, Design of Buried Plant-Physical Considerations
- RUS Bulletin 1751F-641, Construction of Buried Plant
- RUS Bulletin 1751F-642, Construction Route Planning of Buried Plant
- Rural Utilities Service (RUS) 1751F-643 Underground Plant Design
- Rural Utilities Service (RUS) 1751F-644 Underground Plant Construction
- RUS Bulletin 1751F-805, Electrical Protection at Customer Locations
- RUS Bulletin 1753F-401 (PC-2), Standard for Splicing Copper and Fiber Optic Cables
- RUS Form 515a, Specifications and Drawings for Construction of a Direct Buried Plant
- RUS Form 515c, Specifications and Drawings for Conduit and Maintenance hole Construction
- RUS Form 515d, Specifications and Drawings for Underground Cable Installation
- RUS Form 515f, Specifications and Drawings for Construction of Pole Lines, Aerial Cables and Wires
- RUS Form 515g, Specifications and Drawings for Service Entrance and Station Protector Installation
- Unified Facilities Criteria (UFC) 3-520-1 Interior Electrical Systems
- Unified Facilities Criteria (UFC) 3-580-1, Telecommunications Interior

Infrastructure Planning and Design
- Unified Facilities Criteria (UFC) 4-010-05 - Sensitive Compartmented Information Facilities Planning, Design, and Construction
- Unified Facilities Criteria (UFC) 4-010-06 Cybersecurity of Facility
- Unified Facilities Criteria (UFC) Facilities Criteria (UFC) 4-510-01 Design: Military Medical Facilities
- Unified Facilities Criteria (UFC) 4-711-01 Family Housing
- UL 1286, Office Furnishings
- UL 1863, Communication Circuit Accessories
- UL 444, Communications Cables
- UL 467, Grounding and Bonding Equipment
- UL 50, Enclosures for Electrical
- UL 514C, Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
- UL 723, Test for Surface Burning Characteristics of Building Materials
- UL 969, Standard for Marking and Labeling Systems

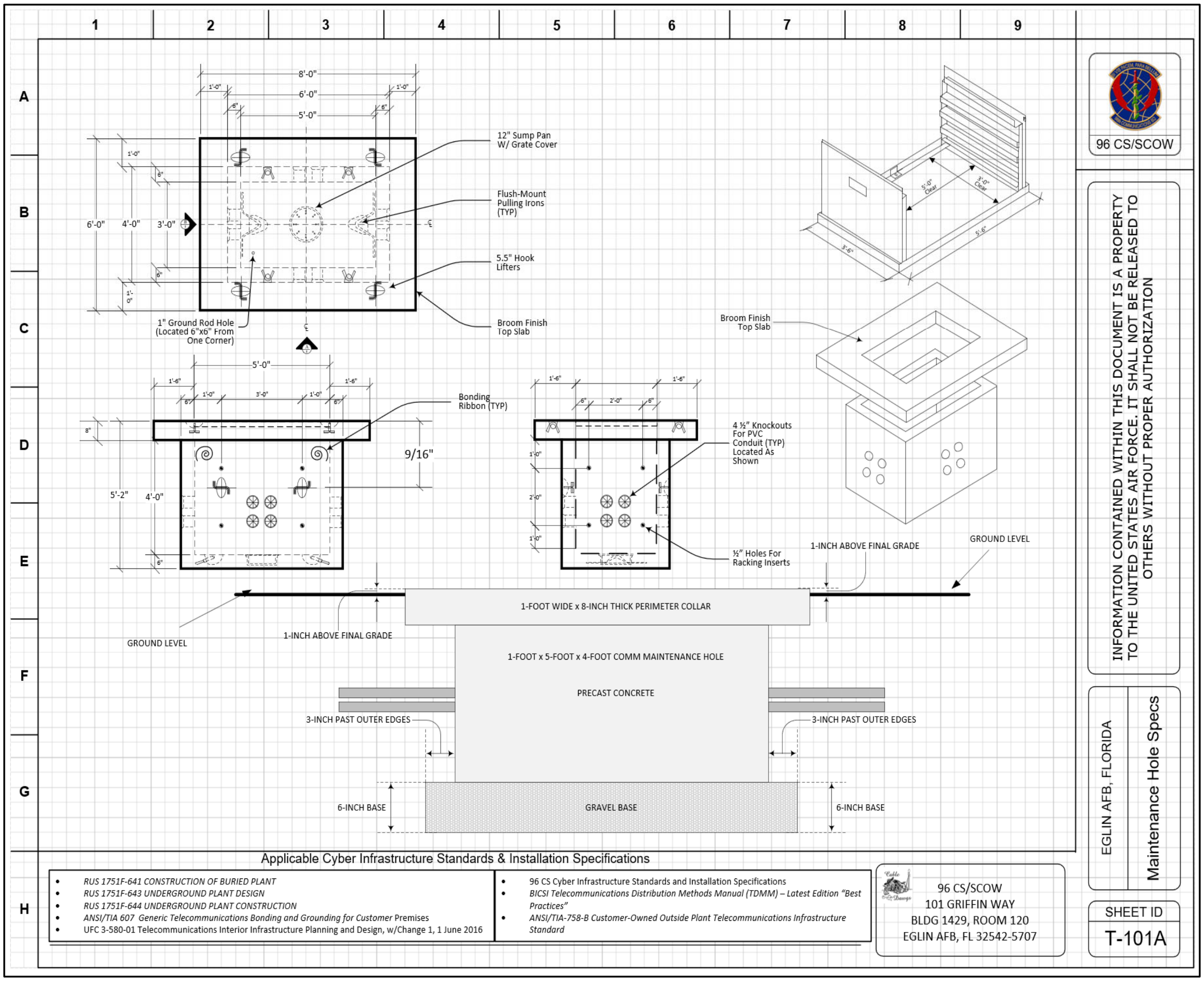
Standards and Installation Specifications

Attachment H

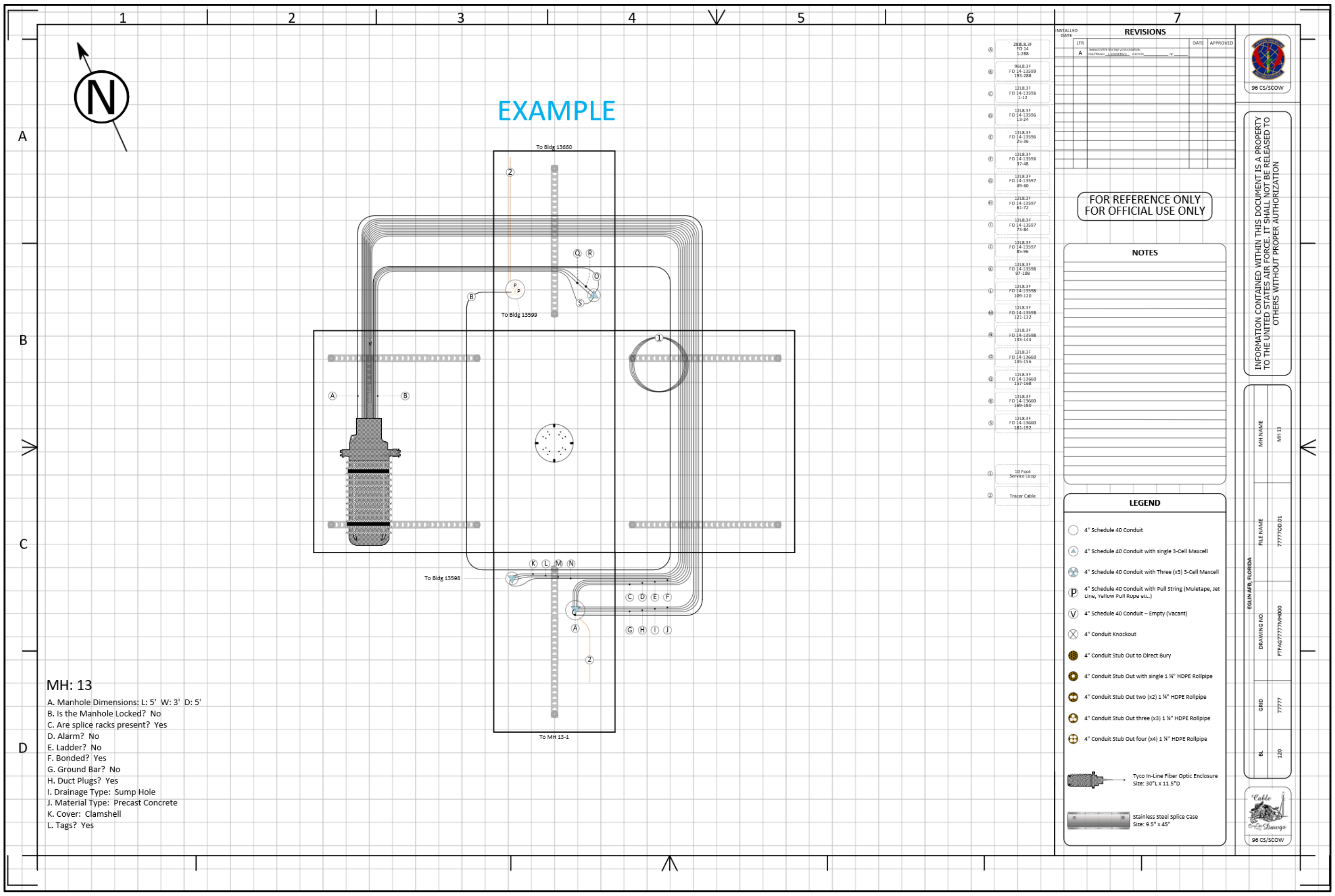
STANDARD INSTALLATION DRAWINGS



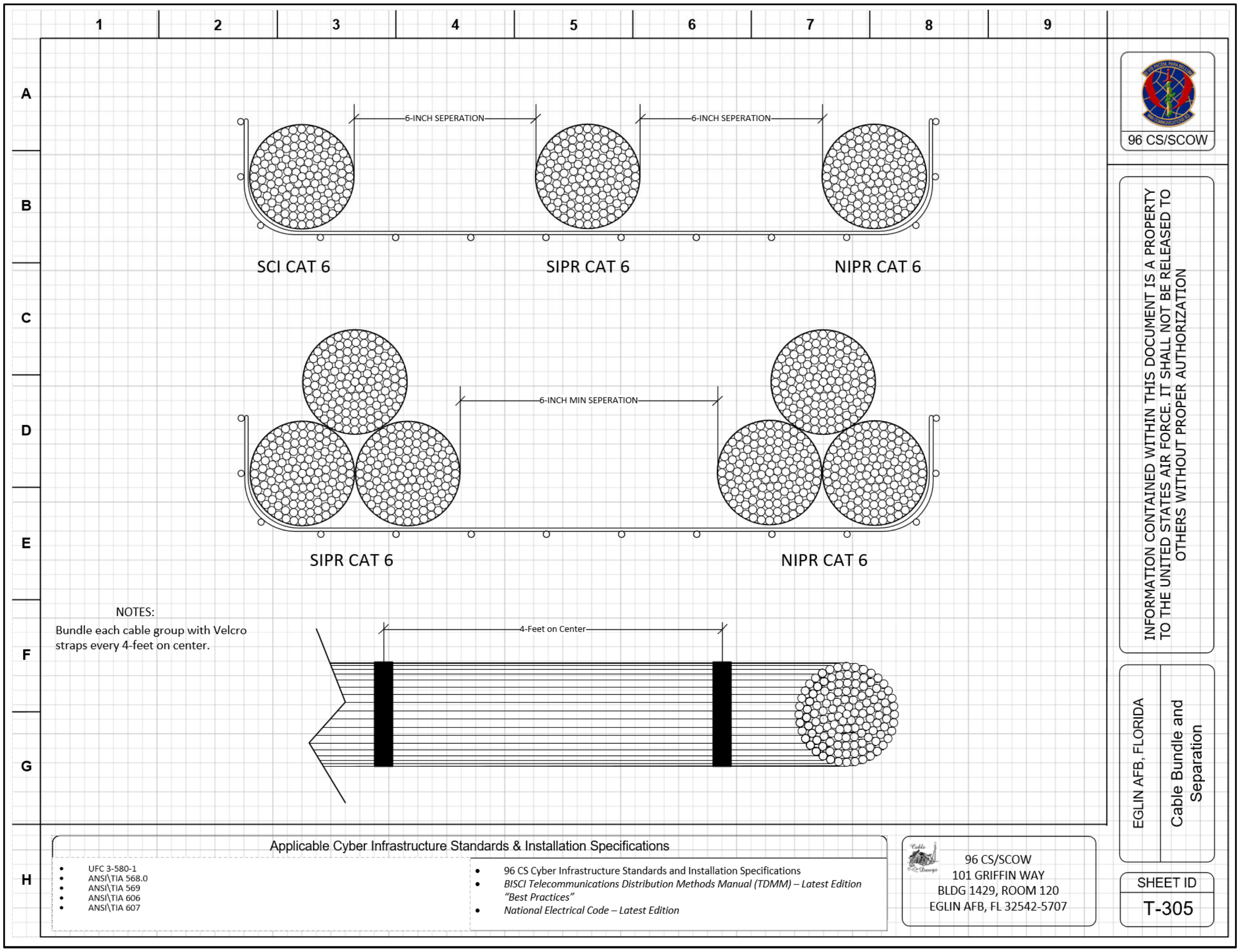
Standards and Installation Specifications



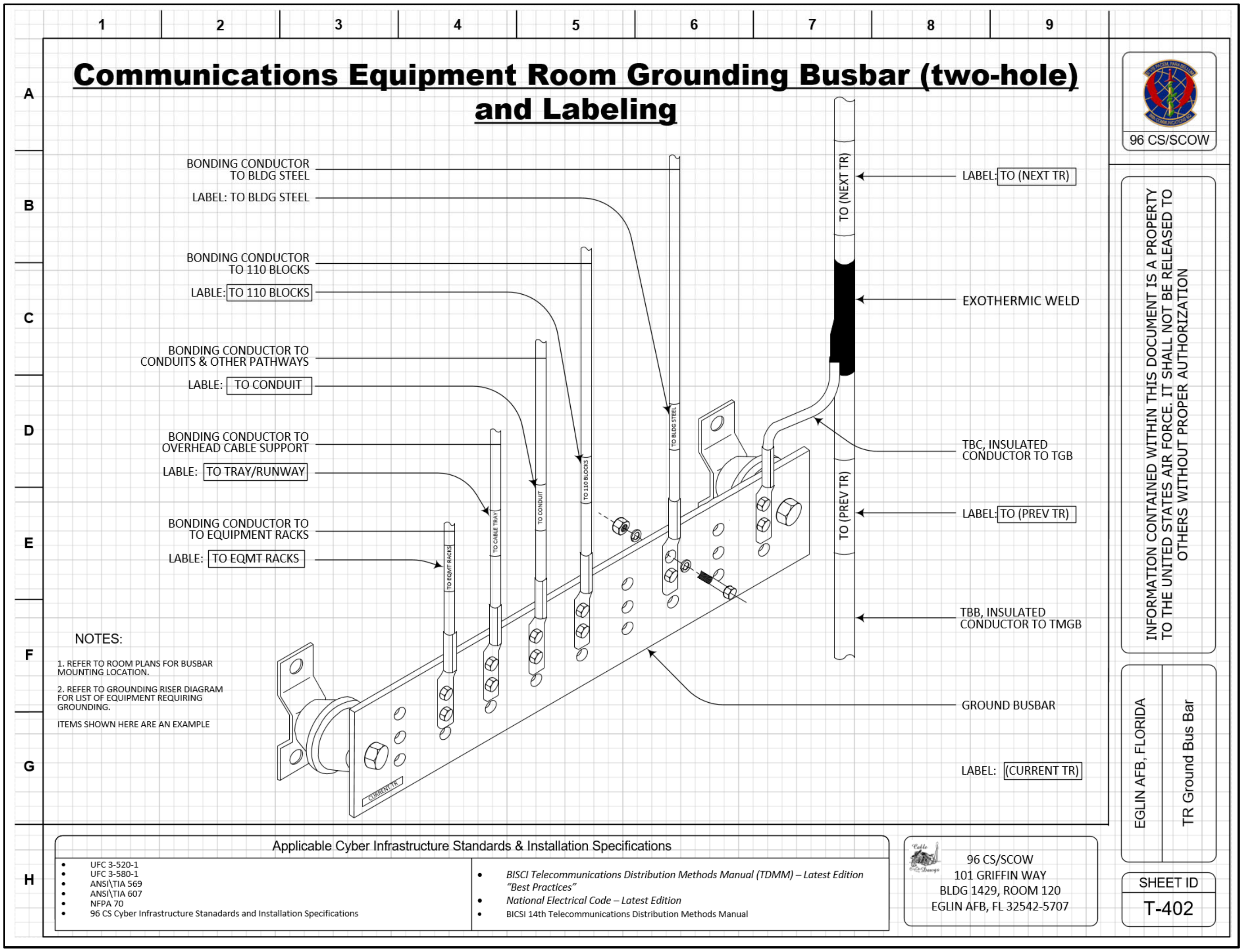
Standards and Installation Specifications



Standards and Installation Specifications



Standards and Installation Specifications

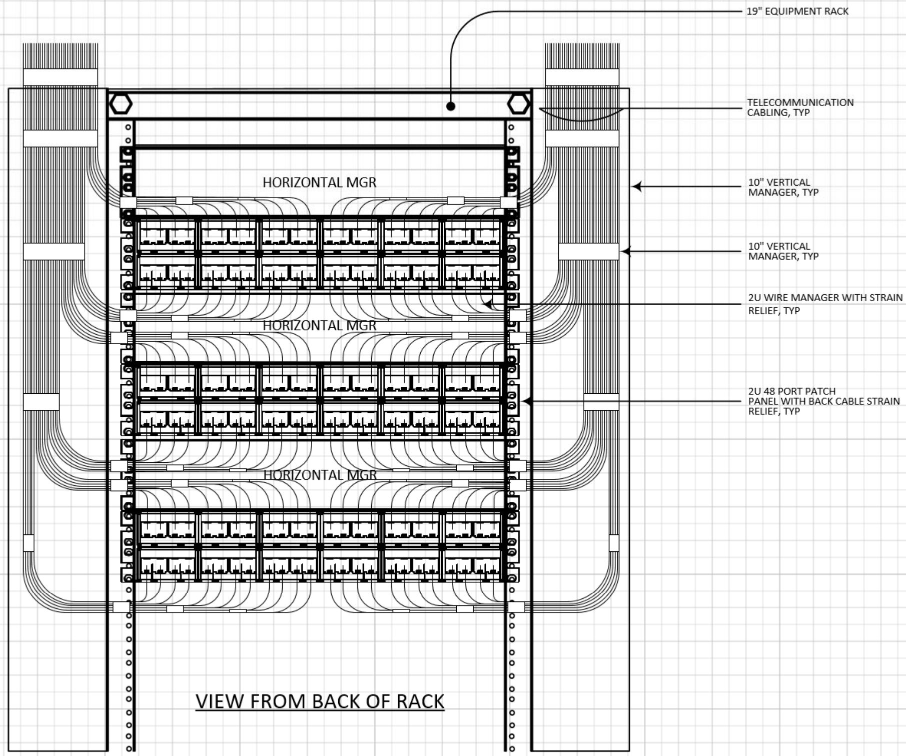


Standards and Installation Specifications

TELECOMMUNICATIONS HORIZONTAL CABLE ROUTING AT EQUIPMENT CABINET OR RACK ASSEMBLY

NOTES:

1. ALL CABLES ROUTED TO CORRESPONDING PATCH PANELS SHALL BE SECURED ON A STRAIN RELIEF BAR PROVIDED WITH PATCH PANEL.



VIEW FROM BACK OF RACK

96 CS/SCOW

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EGLIN AFB, FLORIDA

Telecom Rm – Rack Horizontal Routing

Applicable Cyber Infrastructure Standards & Installation Specifications

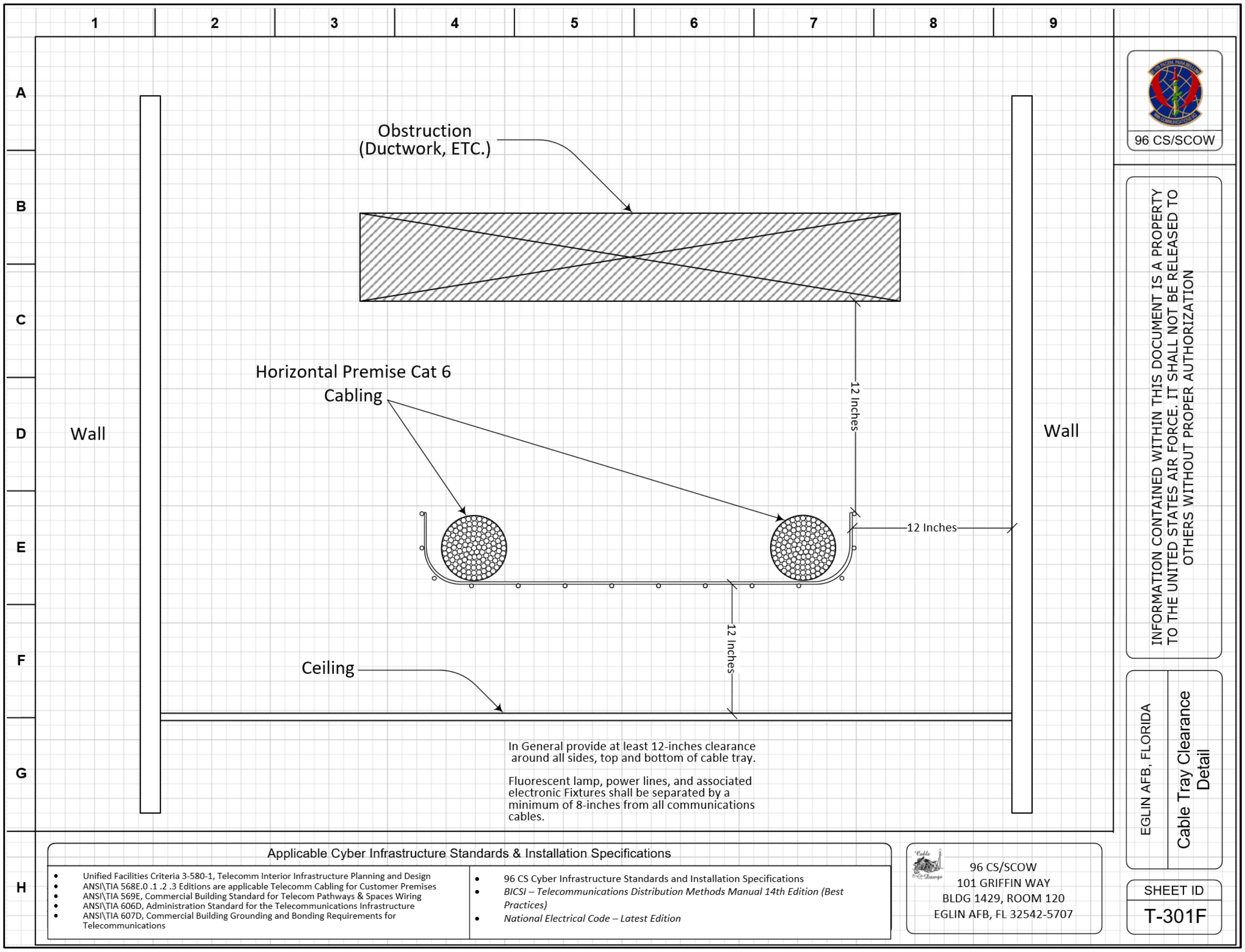
- ANSI\TIA 568
- ANSI\TIA 569
- ANSI\TIA 606
- ANSI\TIA 607
- Unified Facilities Criteria (UFC) 3-580-1 Telecommunications interior Infrastructure Planning and Design
- Unified Facilities Criteria (UFC) 4-010-06 Cybersecurity of Facility
- 96 CS Cyber Infrastructure Standards and Installation Specifications
- BISCI Telecommunications Distribution Methods Manual (TDMM) – Latest Edition "Best Practices"
- National Electrical Code – Latest Edition
-

96 CS/SCOW
101 GRIFFIN WAY
BLDG 1429, ROOM 120
EGLIN AFB, FL 32542-5707

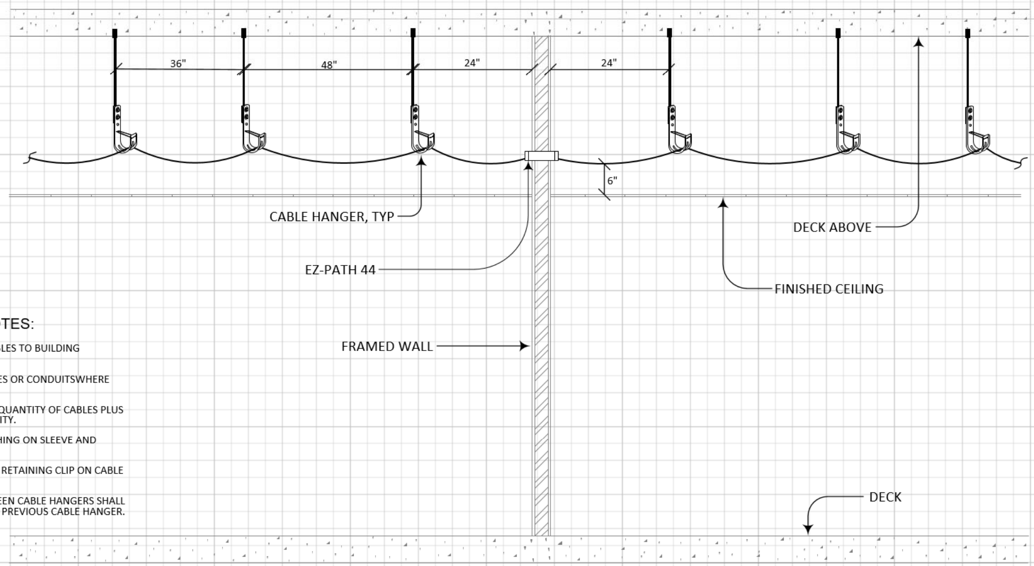
SHEET ID

T-203A

Standards and Installation Specifications



TELECOMMUNICATIONS CABLE ROUTING DETAIL USING J-HOOKS SUPPORT THROUGH FULL HEIGHT PARTITIONS



NOTES:

1. DO NOT TIE CABLES TO BUILDING STRUCTURES.
2. PROVIDE SLEEVES OR CONDUITSWHERE REQUIRED.
3. SIZE BASED ON QUANTITY OF CABLES PLUS 40% SPARE CAPACITY.
4. PROOVIDE BUSHING ON SLEEVE AND COONDUIT ENDS.
5. PROVIDE CABLE RETAINING CLIP ON CABLE HANGERS.
6. SPACING BETWEEN CABLE HANGERS SHALL NOT BE EQUAL TO PREVIOUS CABLE HANGER.

96 CS/SCOW

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EGLIN AFB, FLORIDA

Cable Routing – Full Height Wall

Applicable Cyber Infrastructure Standards & Installation Specifications

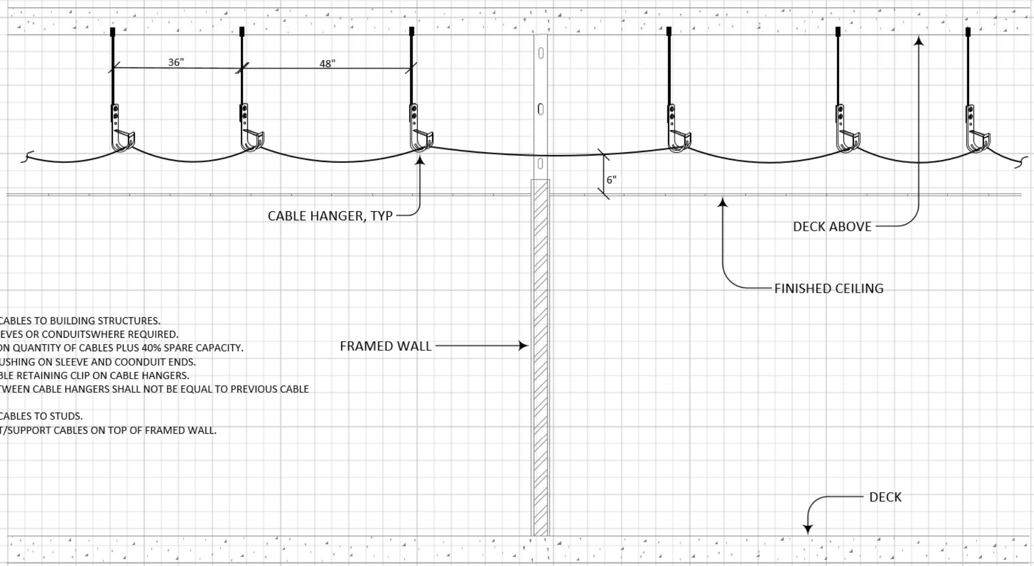
- Unified Facilities Criteria 3-580-1, Telecomm Interior Infrastructure Planning and Design
- ANSI\TIA 568E.0 .1 .2 .3 Editions are applicable Telecomm Cabling for Customer Premises
- ANSI\TIA 569E, Commercial Building Standard for Telecom Pathways & Spaces Wiring
- ANSI\TIA 606D, Administration Standard for the Telecommunications Infrastructure
- ANSI\TIA 607D, Commercial Building Grounding and Bonding Requirements for Telecommunications
- 96 CS Cyber Infrastructure Standards and Installation Specifications
- BICSI – Telecommunications Distribution Methods Manual 14th Edition (Best Practices)
- National Electrical Code – Latest Edition

96 CS/SCOW
101 GRIFFIN WAY
BLDG 1429, ROOM 120
EGLIN AFB, FL 32542-5707

SHEET ID

T-302

TELECOMMUNICATIONS CABLE ROUTING DETAIL USING J-HOOKS SUPPORT FOR LOW PROFILE PARTITIONS



NOTES:

1. DO NOT TIE CABLES TO BUILDING STRUCTURES.
2. PROVIDE SLEEVES OR CONDUITSWHERE REQUIRED.
3. SIZE BASED ON QUANTITY OF CABLES PLUS 40% SPARE CAPACITY.
4. PROOVIDE BUSHING ON SLEEVE AND COONDUIT ENDS.
5. PROVIDE CABLE RETAINING CLIP ON CABLE HANGERS.
6. SPACING BETWEEN CABLE HANGERS SHALL NOT BE EQUAL TO PREVIOUS CABLE HANGER.
7. DO NOT TIE CABLES TO STUDS.
8. DO NOT REST/SUPPORT CABLES ON TOP OF FRAMED WALL.

96 CS/SCOW

INFORMATION CONTAINED WITHIN THIS DOCUMENT IS A PROPERTY TO THE UNITED STATES AIR FORCE. IT SHALL NOT BE RELEASED TO OTHERS WITHOUT PROPER AUTHORIZATION

EGLIN AFB, FLORIDA

Cable Routing – Partition Wall

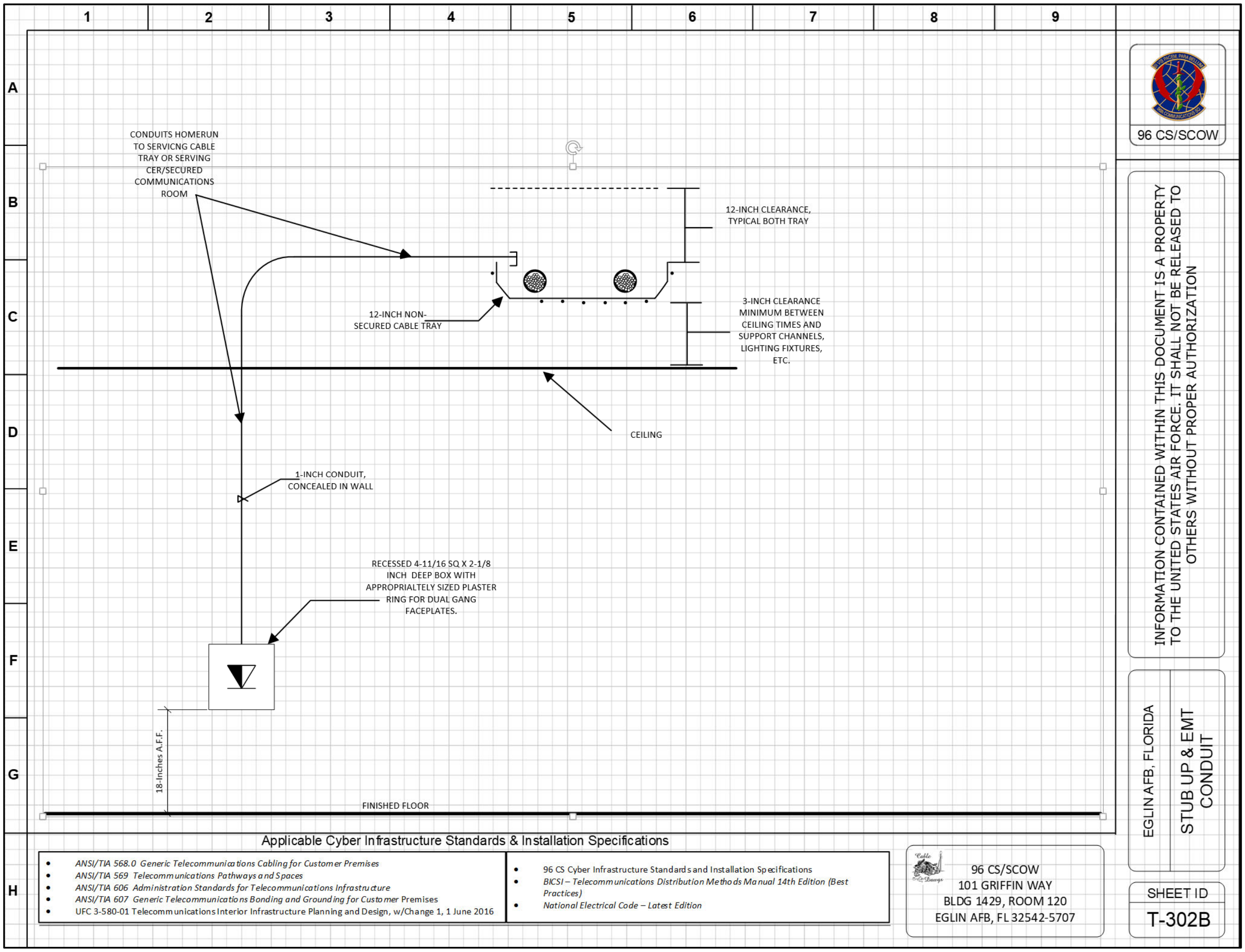
Applicable Cyber Infrastructure Standards & Installation Specifications

- Unified Facilities Criteria 3-580-1, Telecomm Interior Infrastructure Planning and Design
- ANSI\TIA 568E.0 .1 .2 .3 Editions are applicable Telecomm Cabling for Customer Premises
- ANSI\TIA 569E, Commercial Building Standard for Telecom Pathways & Spaces Wiring
- ANSI\TIA 606D, Administration Standard for the Telecommunications Infrastructure
- ANSI\TIA 607D, Commercial Building Grounding and Bonding Requirements for Telecommunications
- 96 CS Cyber Infrastructure Standards and Installation Specifications
- BICSI – Telecommunications Distribution Methods Manual 14th Edition (Best Practices)
- National Electrical Code – Latest Edition

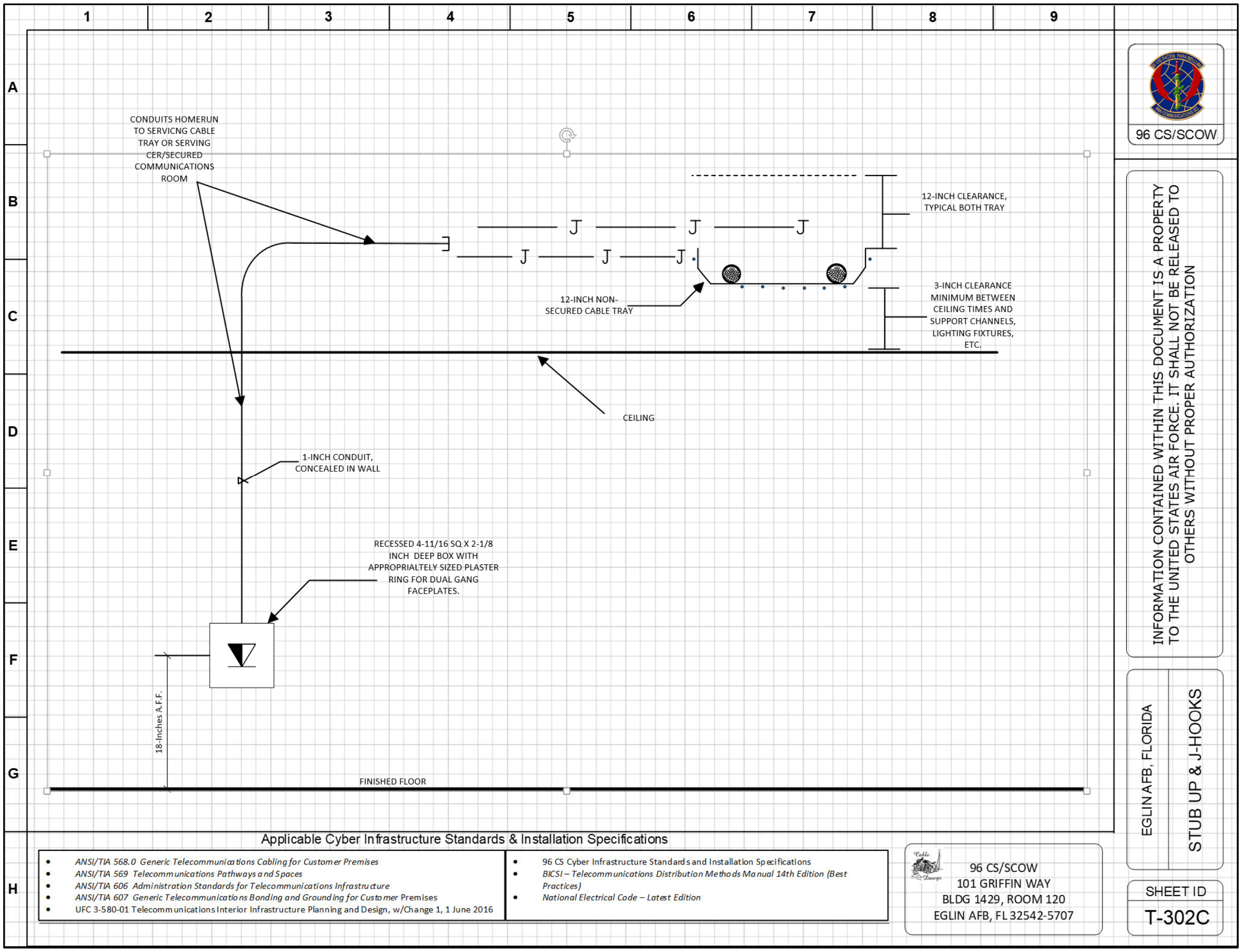
96 CS/SCOW
101 GRIFFIN WAY
BLDG 1429, ROOM 120
EGLIN AFB, FL 32542-5707

SHEET ID
T-302A

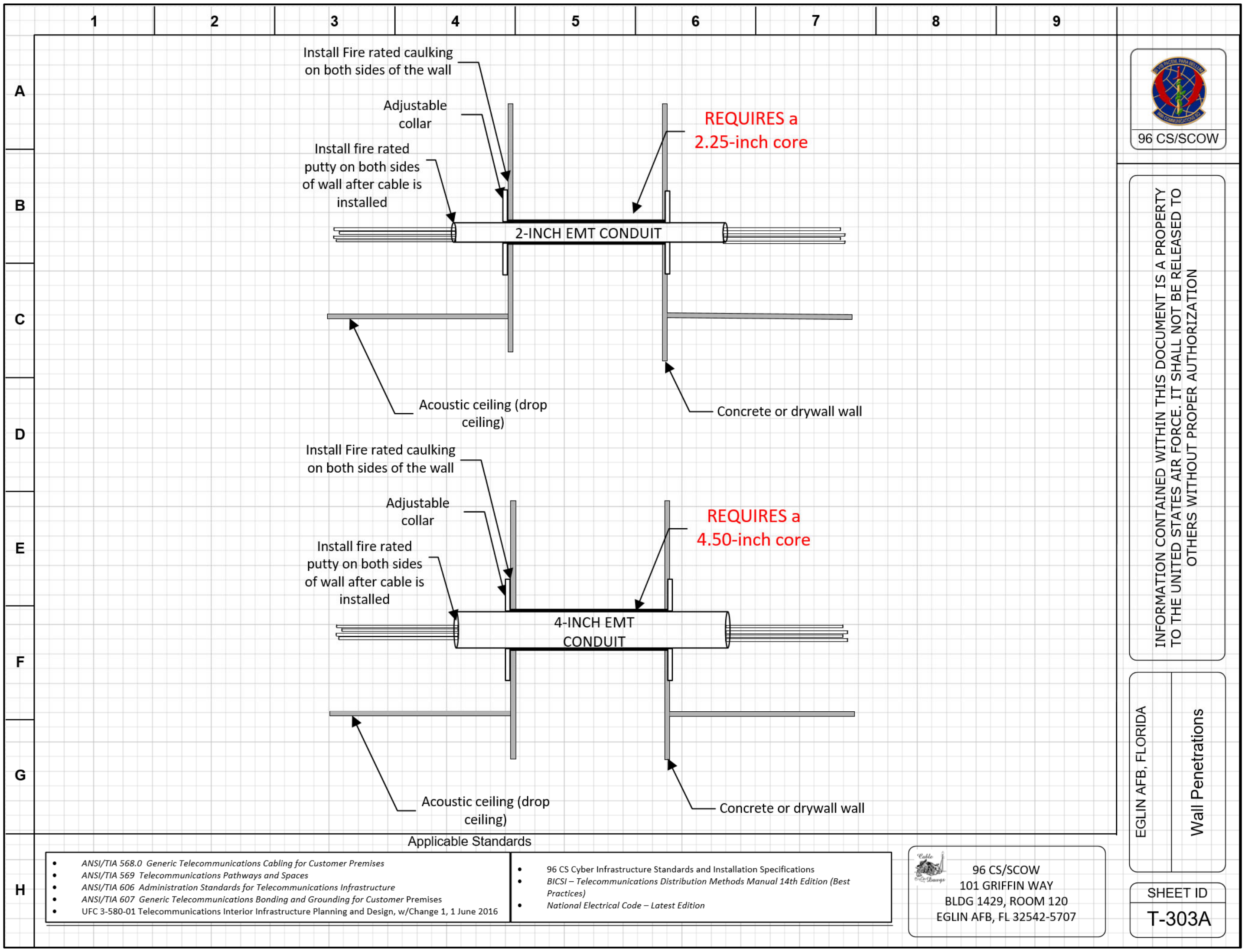
Standards and Installation Specifications

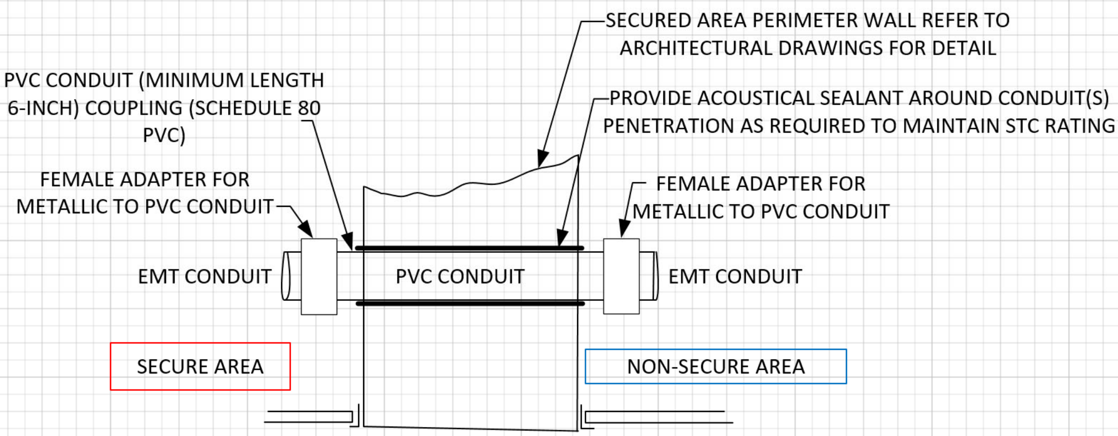


Standards and Installation Specifications



Standards and Installation Specifications





NOTE: PROVIDE ISOLATION FOR ALL ABOVE GROUND METALLIC CONDUITS ENTERING/LEAVING SECURED AREAS THRU DIE-ELECTRIC BREAKS OR BONDING EACH SIDE OF CONDUIT TO BUILDING GROUND.

Die-Electric Isolation Detail

Applicable Cyber Infrastructure Standards & Installation Specifications

- *ANSI/TIA 568.0 Generic Telecommunications Cabling for Customer Premises*
- *ANSI/TIA 569 Telecommunications Pathways and Spaces*
- *ANSI/TIA 606 Administration Standards for Telecommunications Infrastructure*
- *ANSI/TIA 607 Generic Telecommunications Bonding and Grounding for Customer* Premises
- UFC 3-580-01 Telecommunications Interior Infrastructure Planning and Design, w/Change 1, 1 June 2016
- 96 CS Cyber Infrastructure Standards and Installation Specifications
- *BICSI – Telecommunications Distribution Methods Manual 14th Edition (Best Practices)*
- *National Electrical Code – Latest Edition*

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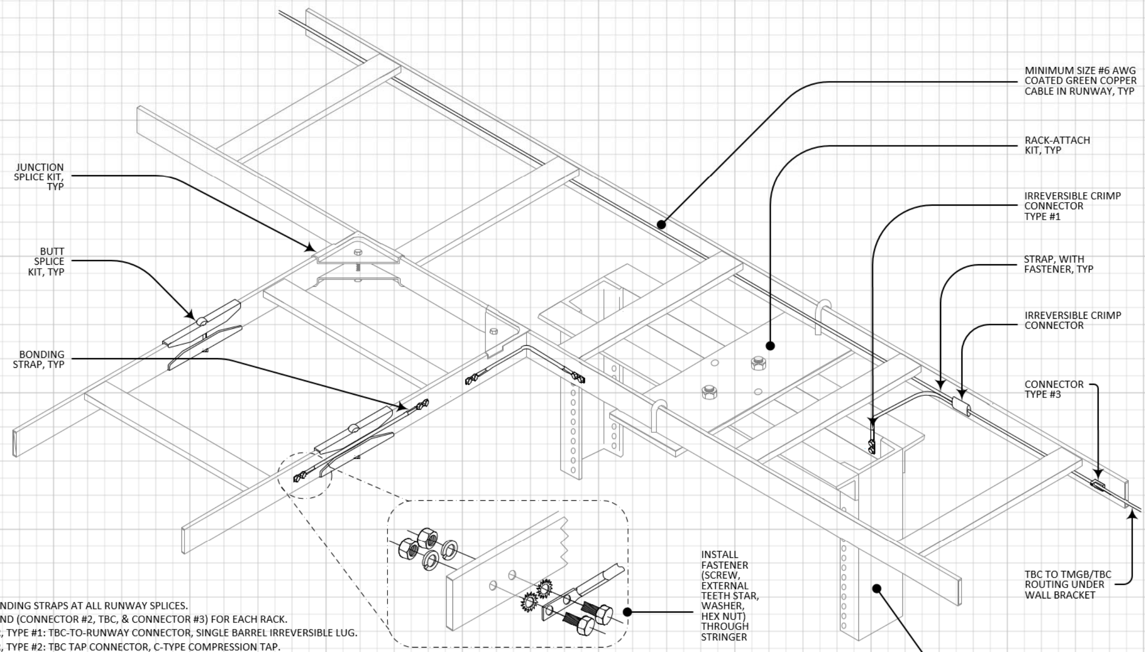
SHEET ID

T-303C

Standards and Installation Specifications

TELECOMMUNICATIONS CABLE RUNWAY BONDING



NOTES:

1. PROVIDE BONDING STRAPS AT ALL RUNWAY SPLICES.
2. PROVIDE BOND (CONNECTOR #2, TBC, & CONNECTOR #3) FOR EACH RACK.
3. CONNECTOR, TYPE #1: TBC-TO-RUNWAY CONNECTOR, SINGLE BARREL IRREVERSIBLE LUG.
4. CONNECTOR, TYPE #2: TBC TAP CONNECTOR, C-TYPE COMPRESSION TAP.
5. CONNECTOR, TYPE #3: TBC-TO-RACK CONNECTOR, BARREL LUG, 1-BOLT/2-HOLE.
6. FASTENER FOR STRAP SHALL CONSIST OF SELF TAPPING SCREW WITH LOCK WASHER. FASTENER LENGTH SHALL NOT IMPEDE ON OPPOSITE SIDE OF STRINGER.
7. GROUND WIRE SHALL BE SEPARATED BY 2-INCHES FROM OTHER CONDUCTORS OR CABLE GROUPS OR INSTALLED UNDER OR OFF THE SIDE OF THE CABLE TRAY.
8. TAG OR LABEL ALL GROUND CONNECTIONS IW ANSI/TIA 606 AND ANSI/TIA 607

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Cable Runway Section Bonding

Applicable Cyber Infrastructure Standards & Installation Specifications

- Unified Facilities Criteria 3-580-1, Telecomm Interior Infrastructure Planning and Design
- Unified Facilities Criteria 3-520-1, Interior Electrical Systems
- ANSI\TIA 569E, Commercial Building Standard for Telecom Pathways & Spaces Wiring
- ANSI\TIA 606D, Administration Standard for the Telecommunications Infrastructure
- ANSI\TIA 607D, Commercial Building Grounding and Bonding Requirements for Telecommunications
- 96 CS Cyber Infrastructure Standards and Installation Specifications
- BICSI – Telecommunications Distribution Methods Manual 14th Edition (Best Practices)
- National Electrical Code – Latest Edition

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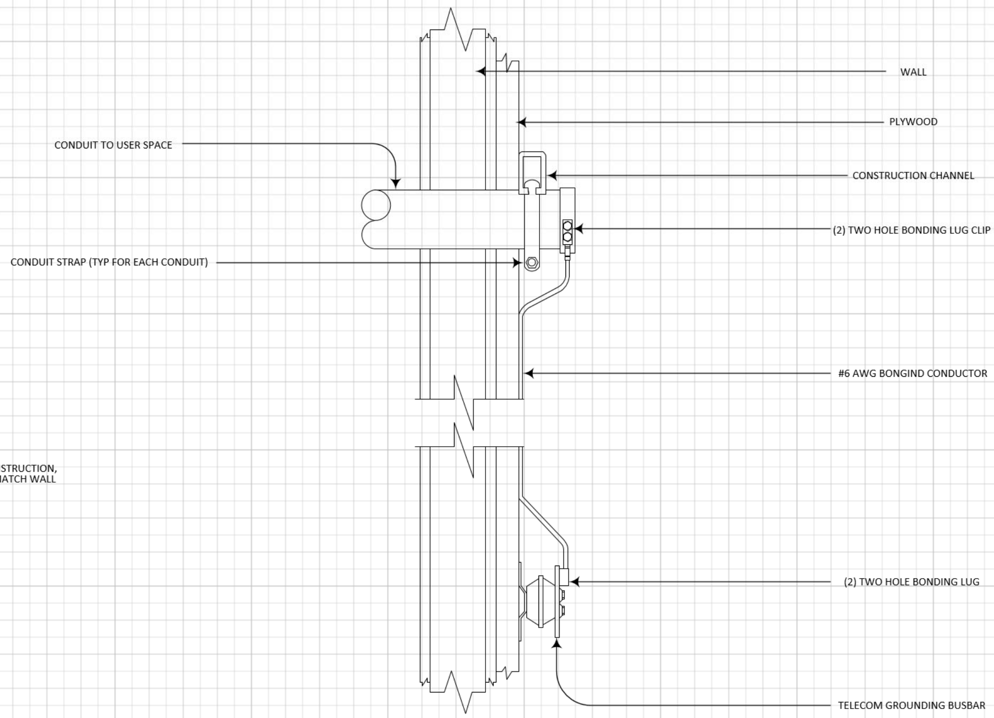
Standards and Installation Specifications

TELECOMMUNICATIONS CONDUIT BONDING



NOTES:

1. FOR FIRE RATED WALL CONSTRUCTION, PROVIDE FIRESTOPPING TO MATCH WALL RATING.

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Conduit Bonding

Applicable Cyber Infrastructure Standards & Installation Specifications

- Unified Facilities Criteria 3-580-1, Telecomm Interior Infrastructure Planning and Design
- ANSI\TIA 569E, Commercial Building Standard for Telecom Pathways & Spaces Wiring
- ANSI\TIA 606D, Administration Standard for the Telecommunications Infrastructure
- ANSI\TIA 607D, Commercial Building Grounding and Bonding Requirements for Telecommunications
- 96 CS Cyber Infrastructure Standards and Installation Specifications
- BICSI – Telecommunications Distribution Methods Manual 14th Edition (Best Practices)
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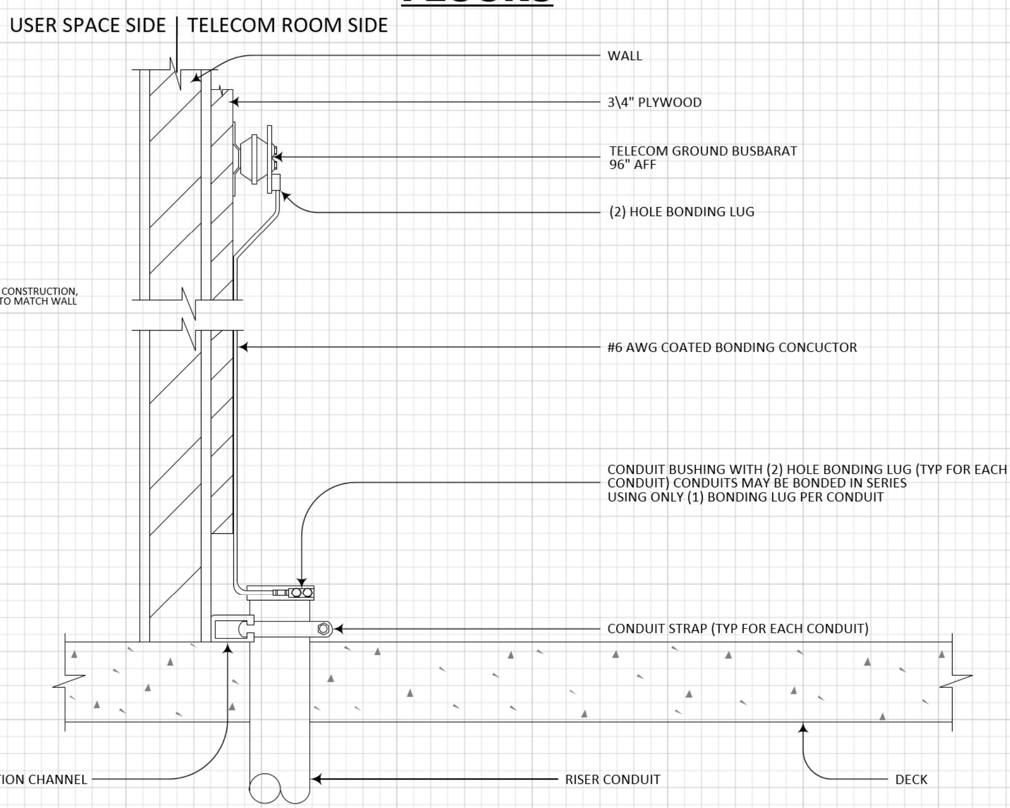
T-406

Standards and Installation Specifications

TELECOMMUNICATIONS RISER CONDUIT BONDING BETWEEN FLOORS



NOTES:

1. FOR FIRE RATED WALL CONSTRUCTION, PROVIDE FIRESTOPPING TO MATCH WALL RATING.

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Riser Conduit Bonding

Applicable Cyber Infrastructure Standards & Installation Specifications

- Unified Facilities Criteria 3-580-1, Telecomm Interior Infrastructure Planning and Design
- ANSI\TIA 568E.0 .1 .2 .3 Editions are applicable Telecomm Cabling for Customer Premises
- ANSI\TIA 569E, Commercial Building Standard for Telecom Pathways & Spaces Wiring
- ANSI\TIA 606D, Administration Standard for the Telecommunications Infrastructure
- ANSI\TIA 607D, Commercial Building Grounding and Bonding Requirements for Telecommunications
- 96 CS Cyber Infrastructure Standards and Installation Specifications
- BICSI – Telecommunications Distribution Methods Manual 14th Edition (Best Practices)
- National Electrical Code – Latest Edition

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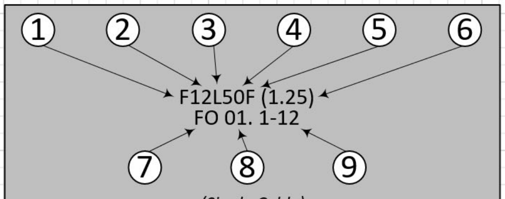
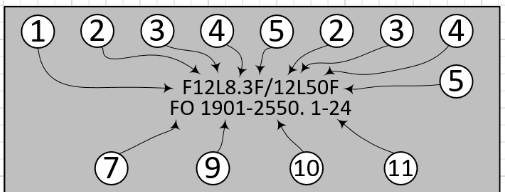
T-406A

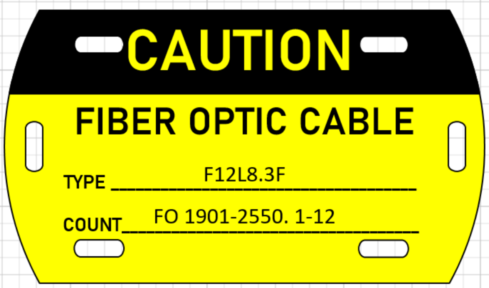
FIBER CABLE TAG INFORMATION



(Single Cable)



(Hybrid Cable)



Fiber Optic Cable

1	-	P = Plenum (Else Leave Blank) R = Riser Rated (Else Leave Blank) F = Indoor/Outdoor
2	-	12 = 12 Strand Fiber Cable (Range is 1-288)
3	-	L = Loose Tube Buffer T = Tight Tube Buffer
4	-	Core Size in Microns Multimode = 50 and 62.5 (UNKNOWN = MM) Singlemode = 8.3, 9.2 or 10 (UNKNOWN = SM) (Cladding is assumed to be 125um, If different include after core size, separated with slash "/")
5	-	F = Filled Core (leave blank for Air Core)
6	-	(1.25) = Cable installed in 1.25" I.D. innerduct 1 = Cable installed in 1" I.D. innerduct Blank = No innerduct
7	-	FO – Fiber Optic Cable
8	-	##### - Cable Number (Range is 01 – 99999)
9	-	#### - Source Building Number
10	-	#### - Destination Building Number
11	-	1 – 12 = Conductor Count

CABLE NUMBERS WILL EITHER USE A SEQUENTIAL NUMBERING PATTERN
OR
SOURCE AND DESTINATION BUILDING NUMBERS

IF THE BUILDING NUMBER METHOD IS USED, THE SOURCE BUILDING WILL BE THE ITN AND DESTINATION WILL BE THE EBN
(BACKBONE CABLES MAY USE EITHER ITN AS THE SOURCE BUILDING)

Applicable Cyber Infrastructure Standards & Installation Specifications

- Unified Facilities Criteria 3-580-1, Telecomm Interior Infrastructure Planning and Design
- ANSI\TIA 606D, Administration Standard for the Telecommunications Infrastructure
- 96 CS Cyber Infrastructure Standards and Installation Specifications
- BICSI – Telecommunications Distribution Methods Manual 14th Edition (Best Practices)
- National Electrical Code – Latest Edition

- Cables shall be label/tagged at ducts, Conduits, service loops and transition entrance and exit points throughout the cable pathway to clearly identify ISP/OSP circuits.

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Fiber Cable Tag Information

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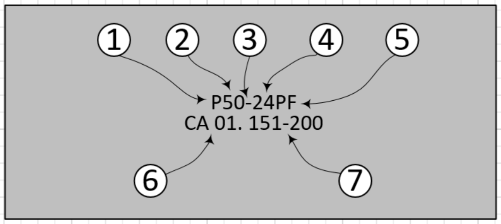
T-501B

COPPER CABLE TAG INFORMATION



Central Office Copper Cable

1 - Cable Outer Protection
P = Plastic Sheath Cable
PP = Double Layer Plastic Sheath Core
Blank = Lead Sheath Cable
A = ABAM Cable
WA = Wire Armored Cable
JP = Jute Protected Cable
TA = Tape Armored Cable
DTA = Double Tape Armored Cable

2 - (Size) Number of Cable Pairs in Sheath (For Greater than 100 pairs Exclued “00”s when labeling cables)

3 - “X” = 24 Pair (or less) Cables
“-“ = 25 pair (or greater) cables

4 - Wire Gauge Size (19, 22, 24, or 26)

5 - Conductor Protection
PF = Plastic Insulated Filled Core Cable
FF = Foam Insulated Filled Core Cable
P = Plastic Insulated Air Core Cable

6 - Cable Number (Two Numeric Digits) “CA” Optional

7 - Inclusive Cable Count(s) (If pairs are Dead/Dead Ended/Abandoned they are on a separate line below and denoted with a plus sign “+” followed by an Alpha Character (Sequential if Multiples) a comma “,” and the Inclusive pair count)

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Copper Cable Tag Information

Applicable Cyber Infrastructure Standards & Installation Specifications

- Unified Facilities Criteria 3-580-1, Telecomm Interior Infrastructure Planning and Design
- ANSI\TIA 606D, Administration Standard for the Telecommunications Infrastructure
- 96 CS Cyber Infrastructure Standards and Installation Specifications
- BICSI – Telecommunications Distribution Methods Manual 14th Edition (Best Practices)
- National Electrical Code – Latest Edition

- Cables shall be label/tagged at ducts, conduits, service loops and transition entrance and exit points throughout the cable pathway to clearly identify ISP/OSP circuits.

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SHEET ID
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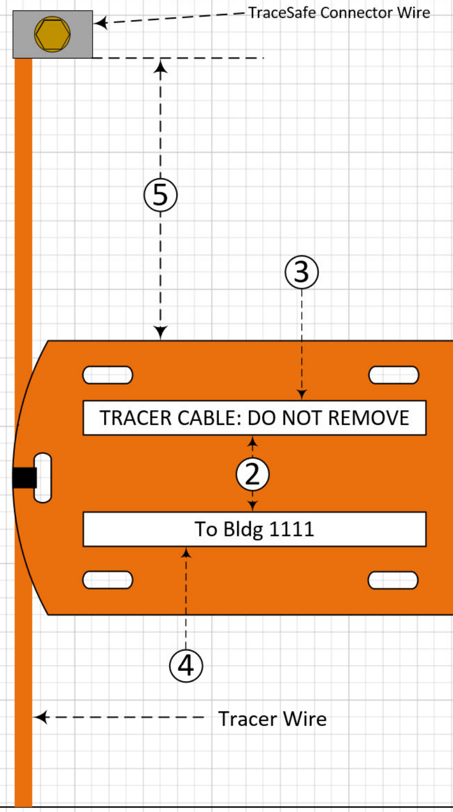
Standards and Installation Specifications

1 2 3 4 5 6 7 8 9

A B C D E F G H



TRACER WIRE LABELING SPECS

①	Use blank orange self-laminating tag measuring 2"x3.5" (part # TG-2284 or Telecommunications tag)
②	Identifier on laser printed adhesive backed label
③	Tag to read: TRACER CABLE: DO NOT REMOVE
④	Identifier to next Maintenance hole, pedestal, building, surface mount equipment, etc.
⑤	Distance Shall Be No Less than 6 Inches and No Greater than 12 Inches

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OSP Tracer Wire Tag

Applicable Cyber Infrastructure Standards & Installation Specifications

- ANSI\TIA 606D, Administration Standard for the Telecommunications Infrastructure
- ANSI\TIA 607D, Commercial Building Grounding and Bonding Requirements for Telecommunications
- ANSI/TIA-758-B Customer-Owned Outside Plant Telecommunications Infrastructure Standard
- 96 CS Cyber Infrastructure Standards and Installation Standards
- *BISCI Telecommunications Distribution Methods Manual (TDMM) – Latest Edition "Best Practices"*
- *National Electrical Code – Latest Edition*

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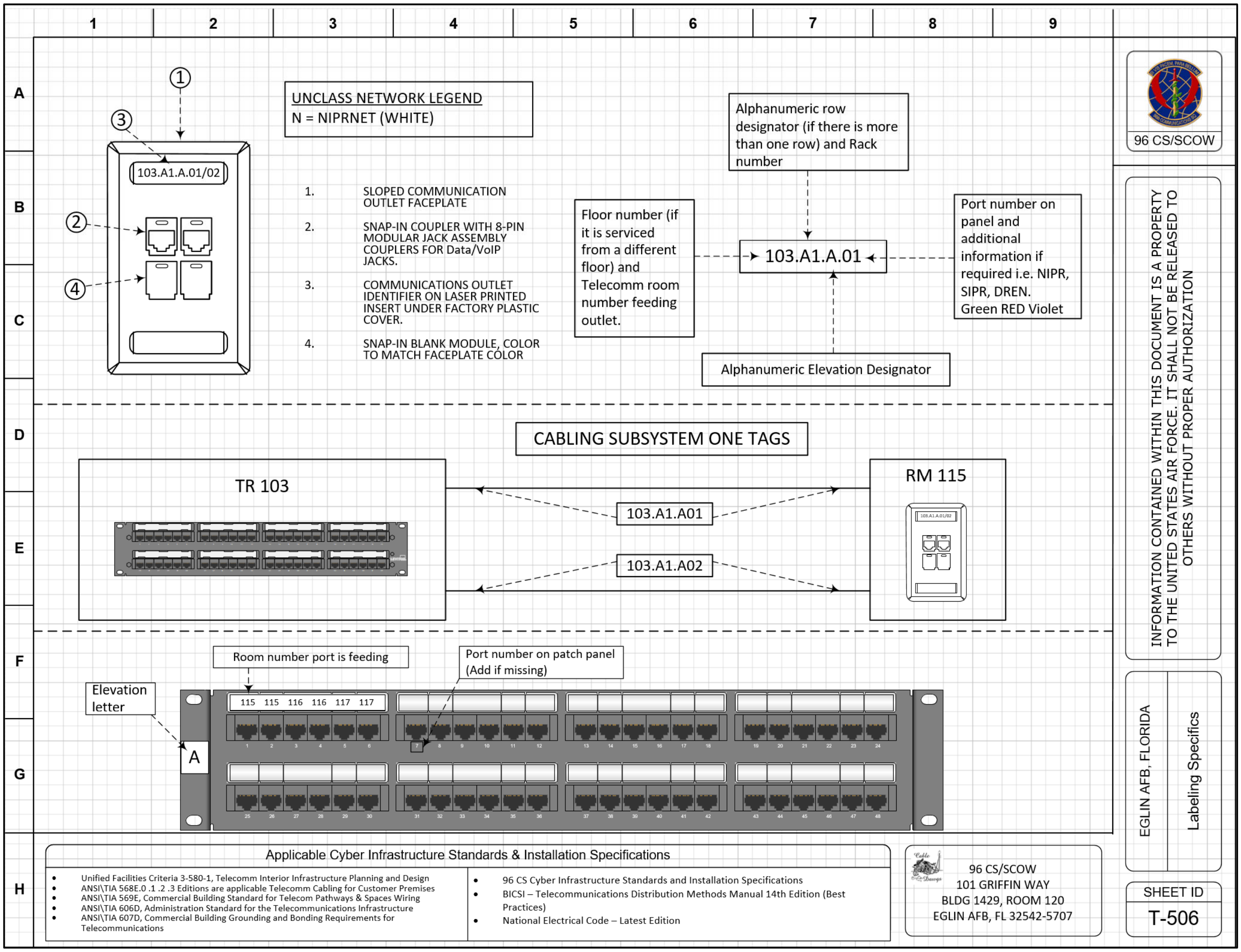
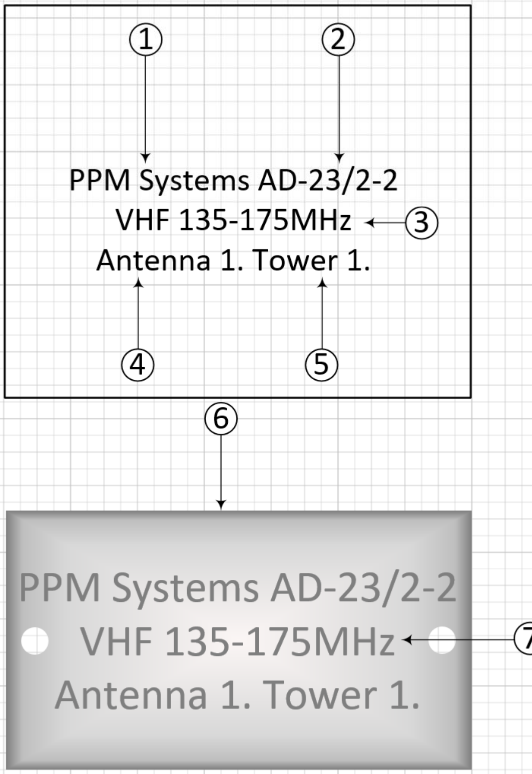
Standards and Installation Specifications



ANTENNA IDENTIFICATION TAG INFORMATION



1	-	Antenna make
2	-	Antenna model number
3	-	Frequency Range
4	-	Antenna #
5	-	Structure (pole 1, pole 2, tower 1, tower 2, etc.)
6	-	Antenna identification Data Tag for Exterior Items (must be UV resistant and designed for outside use; typically stainless steel) Minimum size shall be 1.5" x 3".
7	-	Tag information shall be stamped or embossed onto tag.

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Antenna Identification Tag

Applicable Cyber Infrastructure Standards & Installation Specifications

- Unified Facilities Criteria 3-580-1, Telecomm Interior Infrastructure Planning and Design
- ANSI\TIA 568E.0 .1 .2 .3 Editions are applicable Telecomm Cabling for Customer Premise
- ANSI\TIA 569E, Commercial Building Standard for Telecom Pathways & Spaces Wiring
- ANSI\TIA 606D, Administration Standard for the Telecommunications Infrastructure
- ANSI\TIA 607D, Commercial Building Grounding and Bonding Requirements for Telecommunications
- 96 CS Cyber Infrastructure Standards and Installation Standards
- *BISCI Telecommunications Distribution Methods Manual (TDMM) – Latest Edition "Best Practices"*
- *National Electrical Code – Latest Edition*
- Technical Order 00-33A-1001 Methods & Procedures General Cyberspace Support

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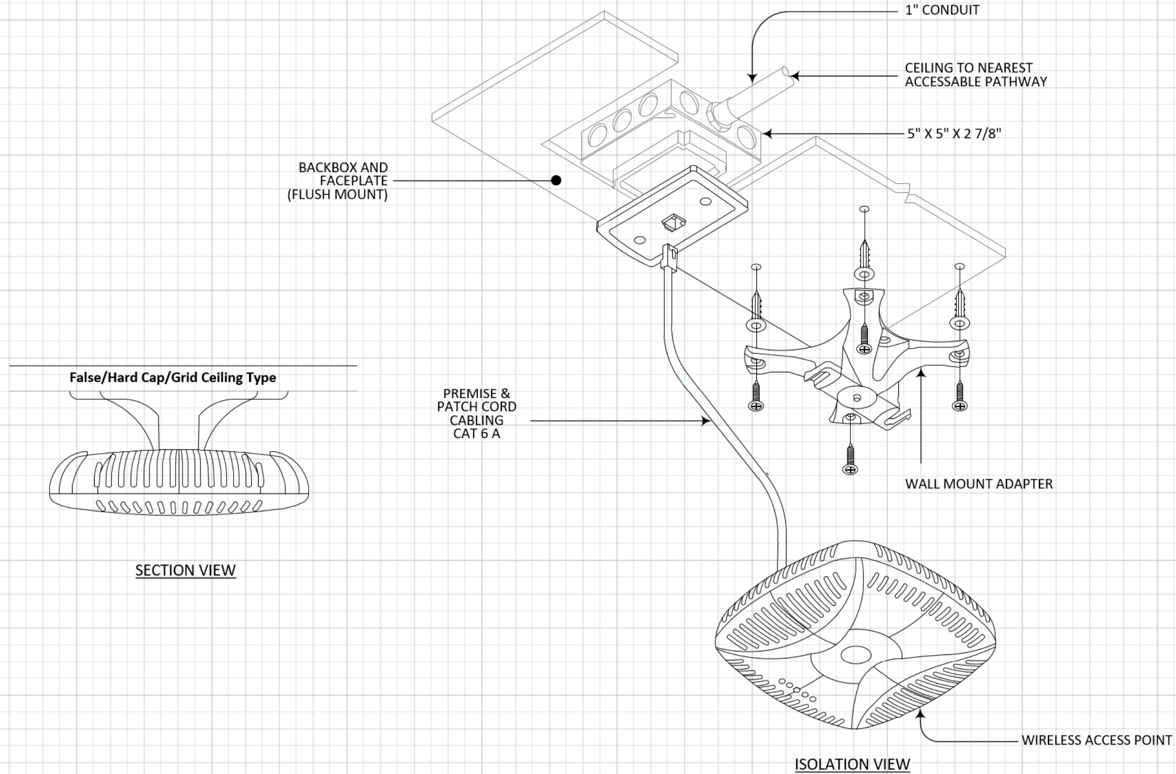
Standards and Installation Specifications

WIRELESS ACCESS POINT MOUNTED IN CEILING



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Wireless Access Point

Applicable Cyber Infrastructure Standards & Installation Specifications

- Unified Facilities Criteria 3-580-1, Telecomm Interior Infrastructure Planning and Design
- ANSI\TIA 568E.0 .1 .2 .3 Editions are applicable Telecomm Cabling for Customer Premises
- ANSI\TIA 569E, Commercial Building Standard for Telecom Pathways & Spaces Wiring
- ANSI\TIA 606D, Administration Standard for the Telecommunications Infrastructure
- ANSI\TIA 607D, Commercial Building Grounding and Bonding Requirements for Telecommunications
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