

**US Army Corps
of Engineers**
Louisville District

Solicitation For

DSSC DLA Repair Building 27 Columbus, OH

P2: 519087

Design-Bid-Build

**Specifications - Vol 2 of 2(Div 21 - 33)
Certified Final Design**

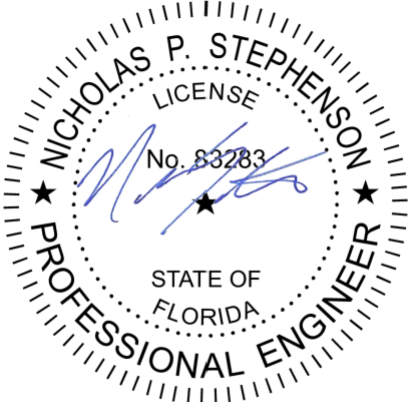
**06 August 2026
W912QR26BA021**

RRS-A: 200A Disposition: Maintain for 15 yrs after construction.

PROJECT SPECIFICATIONS

 03/13/2026	Divisions covered by this seal 00 01 02 04 06 07 08 09 10 12	 03/13/2026	Divisions covered by this seal 22 23
Architectural Ernesto Egoavil, R.A. DLR Group		Mechanical, Plumbing Michael Nickoson, P.E. CMTA	
	Divisions covered by this seal 03 05	 03/13/2026	Divisions covered by this seal 26 28 33
Structural Ryan Robley, P.E. DLR Group		Electrical Jeff Evers, P.E. CMTA	

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

 03/13/2026	Divisions covered by this seal
	21
Fire Protection Nicholas Stephenson MES Group Inc.	

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

PROJECT TABLE OF CONTENTS

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

00 80 00.00 06 04/21, CHG 1: 06/23 SPECIAL PROVISIONS

DIVISION 01 - GENERAL REQUIREMENTS

01 11 00	02/24	SUMMARY OF WORK
01 32 01.00 06	10/23	PROJECT SCHEDULE
01 33 00	08/18, CHG 4: 02/21	SUBMITTAL PROCEDURES
01 35 26.00 06		GOVERNMENT SAFETY REQUIREMENTS
01 42 00	05/24	SOURCES FOR REFERENCE PUBLICATIONS
01 45 00.15 10	11/23	RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM)
01 45 04.10 06	05/25	CONTRACTOR QUALITY CONTROL
01 45 35	05/24	SPECIAL INSPECTIONS
01 50 00	11/20, CHG 3: 08/24	TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
01 57 19.00 06	04/20	TEMPORARY ENVIRONMENTAL CONTROLS AND PERMITS
01 74 19	02/19, CHG 3: 11/21	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
01 78 23	05/23, CHG 1: 05/25	OPERATION AND MAINTENANCE DATA
01 91 00.15	05/23, CHG 3: 08/24	BUILDING COMMISSIONING

DIVISION 02 - EXISTING CONDITIONS

02 41 00	08/22	DEMOLITION AND DECONSTRUCTION
02 82 00	11/18, CHG 1: 11/19	ASBESTOS REMEDIATION
02 83 00	11/18	LEAD REMEDIATION
02 84 16	11/22	HANDLING OF LIGHTING BALLASTS AND LAMPS CONTAINING PCBs AND MERCURY

DIVISION 03 - CONCRETE

03 30 00 02/19, CHG 9: 08/24 CAST-IN-PLACE CONCRETE

DIVISION 04 - MASONRY

04 20 00 11/15, CHG 2: 05/19 UNIT MASONRY

DIVISION 05 - METALS

05 05 20	05/22, CHG 1: 08/24	POST-INSTALLED CONCRETE AND MASONRY ANCHORS
05 05 23.16	08/18	STRUCTURAL WELDING
05 50 13	08/24	MISCELLANEOUS METAL FABRICATIONS
05 50 14	08/18	STRUCTURAL METAL FABRICATIONS
05 52 00	08/23	METAL RAILINGS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 00	08/16, CHG 2: 11/18	ROUGH CARPENTRY
06 61 16	08/20	SOLID SURFACING FABRICATIONS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 24 00 08/23 EXTERIOR INSULATION AND FINISH SYSTEMS

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

07 27 19.01	08/23, CHG 1: 08/24	SELF-ADHERING AIR BARRIERS
07 27 26	08/23	FLUID-APPLIED MEMBRANE AIR BARRIERS
07 60 00	08/23	FLASHING AND SHEET METAL
07 92 00	08/23	JOINT SEALANTS

DIVISION 08 - OPENINGS

08 11 13	08/20	STEEL DOORS AND FRAMES
08 11 16	05/17, CHG 2: 11/18	ALUMINUM DOORS AND FRAMES
08 33 23	08/20, CHG 1: 02/22	OVERHEAD COILING DOORS
08 41 13	08/18, CHG 1: 08/18	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
08 51 13	05/19	ALUMINUM WINDOWS
08 71 00	02/16, CHG 4: 02/22	DOOR HARDWARE
08 81 00	05/19	GLAZING

DIVISION 09 - FINISHES

09 06 00	08/22	SCHEDULES FOR FINISHES
09 29 00	08/24	GYPSUM BOARD
09 30 10	08/20	CERAMIC, QUARRY, AND GLASS TILING
09 51 00	08/20	ACOUSTICAL CEILINGS
09 65 00	11/24	RESILIENT FLOORING
09 68 00	11/24	CARPETING
09 90 00	02/21	PAINTS AND COATINGS

DIVISION 10 - SPECIALTIES

10 14 00.20	08/20	INTERIOR SIGNAGE
10 26 00	08/20	WALL AND DOOR PROTECTION
10 28 13	08/20	TOILET ACCESSORIES
10 51 13	08/24	LOCKERS

DIVISION 12 - FURNISHINGS

12 00 01.00 20	02/23	FURNITURE, FIXTURES AND EQUIPMENT (FF&E) PACKAGE
12 50 00.13 10	08/17, CHG 1: 11/18	FURNITURE AND FURNITURE INSTALLATION

DIVISION 21 - FIRE SUPPRESSION

21 13 13	08/20	WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION
----------	-------	--

DIVISION 22 - PLUMBING

22 00 00	05/24, CHG 1: 11/24	PLUMBING, GENERAL PURPOSE
----------	---------------------	---------------------------

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

23 03 00.00 20	08/10, CHG 3: 08/18	BASIC MECHANICAL MATERIALS AND METHODS
23 05 15	05/22, CHG 2: 08/24	COMMON PIPING FOR HVAC
23 05 48.19	02/25	SEISMIC BRACING FOR MECHANICAL SYSTEMS
23 05 93	05/25	TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 07 00	08/24	THERMAL INSULATION FOR MECHANICAL SYSTEMS
23 08 00	05/23, CHG 1: 08/24	COMMISSIONING OF MECHANICAL AND PLUMBING SYSTEMS

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

23 09 00	08/24, CHG 1: 08/25	INSTRUMENTATION AND CONTROL FOR HVAC
23 09 13	11/15, CHG 2: 05/21	INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
23 09 23.02	08/24	BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS
23 09 53.00 20	02/10, CHG 3: 08/24	SPACE TEMPERATURE CONTROL SYSTEMS
23 09 93	11/15	SEQUENCES OF OPERATION FOR HVAC CONTROL
23 21 23	05/25	HYDRONIC PUMPS
23 30 00	02/25	HVAC AIR DISTRIBUTION
23 36 00.00 40	08/22	AIR TERMINAL UNITS
23 37 13.00 40	08/22	DIFFUSERS, REGISTERS, AND GRILLES
23 57 10.00 10	11/19	FORCED HOT WATER HEATING SYSTEMS USING WATER AND STEAM HEAT EXCHANGERS
23 64 10	05/25	WATER CHILLERS, VAPOR COMPRESSION TYPE
23 64 26	08/09, CHG 7: 02/24	CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS

DIVISION 25 - INTEGRATED AUTOMATION

25 05 11.01	08/24	CYBERSECURITY FOR LOW IMPACT HEATING, VENTILATION AND AIR CONDITIONING (HVAC) FACILITY-RELATED CONTROL SYSTEMS
25 05 11.02	08/24	CYBERSECURITY FOR LOW IMPACT LIGHTING CONTROL SYSTEM (LCS) FACILITY-RELATED CONTROL SYSTEMS

DIVISION 26 - ELECTRICAL

26 05 13	08/25	MEDIUM-VOLTAGE CABLES
26 05 48	11/23	SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT
26 05 73	08/23	POWER SYSTEM STUDIES
26 08 00	11/22	APPARATUS INSPECTION AND TESTING
26 12 19	05/24	PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS
26 20 00	05/25	INTERIOR DISTRIBUTION SYSTEM
26 29 23	02/20, CHG 1: 05/21	ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS
26 51 00	05/20, CHG 2: 11/21	INTERIOR LIGHTING

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 31 76	08/20	INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE
----------	-------	--

DIVISION 33 - UTILITIES

33 71 01	05/19, CHG 1: 11/19	OVERHEAD TRANSMISSION AND DISTRIBUTION
----------	---------------------	--

-- End of Project Table of Contents --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 21 13 13

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 WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2022) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2021) Ductile-Iron and Gray-Iron Fittings
AWWA C111/A21.11	(2023) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C203	(2020) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M	(1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2024) 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	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASTM A183 (2014; R 2020) Standard Specification for
Carbon Steel Track Bolts and Nuts

ASTM A536 (2024) Standard Specification for Ductile
Iron Castings

FM GLOBAL (FM)

FM 1637 (2010) Flexible Sprinkler Hose with
Threaded End Fittings

FM APP GUIDE (updated on-line) Approval Guide
<https://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 (2025; TIA 24-1; TIA 24-2; TIA 24-3)
Standard for the Installation of Sprinkler
Systems

NFPA 13R (2025) Standard for the Installation of
Sprinkler Systems in Low-Rise Residential
Occupancies

NFPA 24 (2025) Standard for the Installation of
Private Fire Service Mains and Their
Appurtenances

NFPA 101 (2024) Life Safety Code

NFPA 291 (2025) 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

UL SOLUTIONS (UL)

UL 193 (2016) UL Standard for Safety Alarm Valves

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

for Fire-Protection Service

UL 199	(2020) UL Standard for Safety Automatic Sprinklers for Fire-Protection Service
UL 262	(2004; Reprint Jul 2023) Gate Valves for Fire-Protection Service
UL 312	(2022) 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 Oct 2021) UL Standard for Safety Hose Valves for Fire-Protection Service
UL 2443	(2015; Reprint May 2020) UL Standard for Safety Flexible Sprinkler Hose with Fittings for Fire Protection Service
UL Fire Prot Dir	UL Product IQ (updated online) at https://productiq.ulprospector.com/en

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. 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 7-23-2025 at 3990 E Broad St and resulted in a static pressure of 65 psi with a residual pressure of 45 psi while flowing 3470 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 on flow test noted in this paragraph, unless approved by Contracting Officer. Hydraulic calculations must be based upon the Hazen-Williams formula with a "C" value noted in NFPA 13 for piping, ..

1.2.1.2 Hydraulic Calculations

<OLG>

<OLI>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.</OLI>

<OLI>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.</OLI>

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

<OLI>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.</OLI>

<OLI>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.</OLI>

<OLI>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.</OLI>

<OLI>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.</OLI>

<OLI>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.</OLI>

</OLG>

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. An allowance for interior hose stations of 100 gpm must be added to the sprinkler system demand.

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:

<OLG>

<OLI>Sprinklers may be omitted from small rooms which are exempted for specific occupancies in accordance with NFPA 101.</OLI>

<OLI>Facilities that are designed in accordance with NFPA 13R.</OLI>

</OLG>

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:

<OLG>

<OLI>Reviewing SD-02, SD-03, and SD-05 submittal packages for completeness

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.</OLI>

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

<OLI>Performing in-progress construction surveillance prior to installation of ceilings (rough-in inspection).</OLI>

<OLI>Witnessing pre-Government and final Government functional performance testing and performing a final installation review.</OLI>

<OLI>Signing applicable certificates under SD-07.</OLI>
</OLG>

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 information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. 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

Pipe; G,
Fittings; G,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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; G, Nameplates; G,

SD-05 Design Data

Seismic Bracing; G,
Load calculations for sizing of seismic bracing
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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4.1.1 Shop Drawing

4 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:

<OLG>

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

<OLI>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.</OLI>

<OLI>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.</OLI>

<OLI>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.</OLI>

<OLI>Plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance.</OLI>

<OLI>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.</OLI>

<OLI>Details of each type of riser assembly, pipe hanger, sway bracing for earthquake protection, 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.</OLI>

<OLI>Details of each type of pipe hanger, seismic bracing/restraint and related components.</OLI>

1.4.1.2 Product Data

4 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. Calculations must include isometric diagram indicating hydraulic nodes and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

pipe segments.

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 IV 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 UNDERGROUND PIPING COMPONENTS

2.2.1 Pipe

Pipe must comply with NFPA 24. Minimum pipe size is 4 inches. Piping more than 5 feet outside the building walls must comply with Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING. A continuous section of welded stainless steel fire water service piping from a point outside the building perimeter to a flanged fitting at least 1-foot above the finished floor within the building is acceptable.

2.2.2 Fittings and Gaskets

Fittings must be ductile-iron conforming to AWWA C110/A21.10 with cement mortar lining conforming to AWWA C104/A21.4. Gaskets must be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile-iron pipe joints must conform to AWWA C111/A21.11.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.3 Gate Valve

Installation must comply with NFPA 24. Gate valves for use with indicator post must conform to UL 262.

2.2.4 Valve Boxes

Except where indicator posts are provided, for each buried valve, provide a cast-iron, ductile-iron, or plastic valve box of a suitable size. Plastic boxes must be constructed of acrylonitrile-butadiene-styrene (ABS) or inorganic fiber-reinforced black polyolefin. Provide cast-iron, ductile-iron, or plastic cover for valve box with the word "WATER" cast on the cover. The minimum box shaft diameter must be 5.25 inches. Coat cast-iron and ductile-iron boxes with bituminous paint applied to a minimum dry-film thickness of 10 mils.

2.2.5 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape must be detectable by an electronic detection instrument. Provide tape, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold block letters continuously and repeatedly over the entire tape length. Warning and identification must read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.3 ABOVEGROUND PIPING COMPONENTS

2.3.1 Steel Piping Components

2.3.1.1 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 minimum Schedule 40 for sizes 2 inches and less; and minimum Schedule 10 for sizes larger than 2 inches. Steel piping with wall thickness less than Schedule 40 must not be threaded. Grooved pipe must be cut-grooved.

2.3.1.2 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. Saddle tees using rubber gasketed fittings are permitted only when connecting to existing piping for additions or modifications. Saddle tees must use a connection method that completely wraps around the pipe. Reducing couplings are not permitted except as allowed by NFPA 13.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.3.1.3 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.

2.3.1.4 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.

2.3.2 Flexible Sprinkler Hose

Flexible sprinkler hose must comply with UL 2443 and FM 1637.

2.3.3 Pipe Hangers and Supports

Provide galvanized pipe hangers, supports and seismic bracing in accordance with NFPA 13. Design and install seismic protection in accordance with the requirements of NFPA 13 section titled "Protection of Piping Against Damage Where Subject to Earthquakes for Seismic Design Category "B".

2.3.4 Valves

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

2.3.4.1 Control Valve

Manually operated sprinkler control/gate valve must be outside stem and yoke (OS&Y) type or butterfly type as indicated on the drawings and must be listed.

2.3.4.2 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.

2.3.4.3 Hose Valve

Valve must comply with UL 668.

2.3.5 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.4 ALARM INITIATING AND SUPERVISORY DEVICES

2.4.1 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.

2.4.2 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.

2.5 FIRE DEPARTMENT CONNECTION

Fire department connection must be projecting type with cast-brass body, matching wall escutcheon lettered "Auto Spkr" with a chromium-plated 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. 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 8.0.

2.6.3 Sidewall Sprinkler

Sidewall sprinkler must be the quick-response type. Sidewall sprinkler must have a nominal K-factor of 8.0. Sidewall sprinkler must have a polished-chrome finish.

2.6.4 Concealed Sprinkler

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 as indicated.

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

Air vents must be of the automatic type and 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

<OLG>

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

<OLI>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.</OLI>

<OLI>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.</OLI>
</OLG>

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 UNDERGROUND PIPING INSTALLATION

The fire protection water main must be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover must be 3 feet or the frost line, whichever is deeper. The supply line must terminate inside the building with a flanged piece, the bottom of which must be set not less than 1-foot above the finished floor. A blind flange must be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block must be provided at the elbow where the pipe turns up toward the floor. In addition, joints must be anchored in accordance with NFPA 24. Buried steel components must be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls must meet the requirements of Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.4 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.

3.4.1 Protection of Piping Against Earthquake Damage

Seismic restraint is required.

3.4.2 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.

3.4.3 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.

3.4.4 Pendent Sprinklers

<OLG>

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

<OLI>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.</OLI>

<OLI>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.</OLI>

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

<OLI>Dry pendent sprinklers must be of the required length to permit the sprinkler to be threaded directly into a branch line tee.</OLI>

<OLI>Where the maximum static or flowing pressure, whichever is greater at the sprinkler, applied other than through the fire department connection, exceeds 100 psi and a branch line above the ceiling supplies sprinklers in a pendent position below the ceiling, the cumulative horizontal length of an unsupported armover to a sprinkler or sprinkler drop must not exceed 12 inches for steel pipe and 6 inches for copper tube.</OLI>

</OLG>

3.4.5 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.4.6 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.

3.4.7 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.

3.4.8 Pipe Penetrations

<OLG>

<OLI>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.</OLI>

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

<OLI>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.</OLI>

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

3.4.9 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.4.10 Drains

<OLG>

<OLI>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.</OLI>

<OLI>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.</OLI>

</OLG>

3.4.11 Installation of Fire Department Connection

Connection must be mounted on the exterior wall approximately 3 feet above finished grade. The piping between the connection and the check valve must be provided with an automatic drip in accordance with NFPA 13 and piped to drain to the outside or a floor drain within the same room.

3.4.12 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.

3.5 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.

3.6 PAINTING

Color code mark piping red.

3.7 FIELD QUALITY CONTROL

3.7.1 Test Procedures

Submit detailed test procedures, prepared and signed by the NICET Level III or IV Fire Sprinkler Technician, and the representative of the installing company, and reviewed by the QFPE 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

test data forms must be used for the pre-Government testing and the Government final testing.

<OLG>

<OLI>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.</OLI>

</OLG>

3.7.2 Pre-Government Testing

3.7.2.1 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.

<OLG>

<OLI>NFPA 13 Aboveground Material and Test Certificate</OLI>

<OLI>NFPA 13 Underground Material and Test Certificate</OLI>

</OLG>

3.7.2.2 Request for Government Final Test

When the verification of compliant installation has been completed, submit a formal request for Government final test to the Designated Fire Protection Engineer (DFPE). 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.

3.7.3 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.

3.7.4 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:

<OLG>

<OLI>The manufacturer's technical representative.</OLI>

<OLI>b. The contractor's Qualified Fire Protection Engineer (QFPE).</OLI>

<OLI>Marked-up red line drawings of the system as actually installed.</OLI>
</OLG>

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Government Final Tests will be witnessed by the DOR, Designated Fire Protection Engineer. At this time, all required tests noted in the paragraph "Minimum System Tests" must be repeated at their discretion.

3.8 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.

3.8.1 Underground Piping

3.8.1.1 Flushing

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

3.8.1.2 Hydrostatic Test

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

3.8.2 Aboveground Piping

3.8.2.1 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.

3.8.2.2 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.

3.8.3 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.9 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.

<OLG>

<OLI>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.

<OLI>Provide operating and maintenance (O&M) instructions.</OLI>

</OLG>

3.10 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.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE
05/24, CHG 1: 11/24

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 NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|-----------------------|---|
| ANSI Z21.10.1/CSA 4.1 | (2019; R 2024) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less |
| ANSI Z21.10.3/CSA 4.3 | (2019; R 2024) Gas-Fired Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous |
| ANSI Z21.22/CSA 4.4 | (2015; R 2020) Relief Valves for Hot Water Supply Systems |

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 146 | (2020) Method of Testing and Rating Pool Heaters (ANSI Approved) |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- | | |
|----------------|---|
| ASME A112.1.2 | (2012; R 2017; R 2022) Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors) |
| ASME A112.6.3 | (2022) Floor Drains |
| ASME A112.14.1 | (2003; R 2017; R 2022) Backwater Valves |
| ASME B1.20.1 | (2013; R 2018) Pipe Threads, General Purpose (Inch) |
| 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 B16.5 | (2020) Pipe Flanges and Flanged Fittings |

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

	NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.12	(2019) Cast Iron Threaded Drainage Fittings
ASME B16.15	(2024) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2021) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2021) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2021) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(2022) Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves Classes 150, 300, 600, 900, 1500, and 2500
ASME B16.29	(2022) Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.50	(2021) Wrought Copper and Copper Alloy Brazed-Joint Pressure Fittings
ASME B16.51	(2013) Copper and Copper Alloy Press-Connect Pressure Fittings
ASME B31.1	(2024) Power Piping
ASME B31.9	(2020) Building Services Piping
ASME B40.100	(2022) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2017) BPVC Section IV-Rules for Construction of Heating Boilers
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME BPVC SEC VIII D1	(2023) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1
ASME CSD-1	(2024) Control and Safety Devices for Automatically Fired Boilers

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2021) Performance Requirements for Atmospheric Type Vacuum Breakers
ASSE 1003	(2020) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
ASSE 1010	(2021) Performance Requirements for Water Hammer Arresters
ASSE 1011	(2017) Performance Requirements for Hose Connection Vacuum Breakers
ASSE 1012	(2023) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent
ASSE 1013	(2021) Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies
ASSE 1017	(2023) Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems - (ANSI approved 2010)
ASSE 1019	(2023) Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance
ASSE 1020	(2020) Performance Requirements for Pressure Vacuum Breaker Assemblies

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	(2017) Standard Methods for the Examination of Water and Wastewater
AWWA C606	(2022) Grooved and Shouldered Joints
AWWA C651	(2023) Standard for Disinfecting Water Mains
AWWA C652	(2019) Disinfection of Water-Storage Facilities
AWWA D100	(2021) Welded Steel Tanks for Water Storage

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS B2.2/B2.2M	(2016) Specification for Brazing Procedure and Performance Qualification

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M	(1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A74	(2021) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A105/A105M	(2023) 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	(2024a) 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 A518/A518M	(1999; R 2022) Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
ASTM A536	(2024) Standard Specification for Ductile Iron Castings
ASTM A733	(2016; R 2022) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A888	(2024) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B42	(2020) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B43	(2020) Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B75/B75M	(2020) Standard Specification for Seamless

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Copper Tube

ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B152/B152M	(2019) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B306	(2020) Standard Specification for Copper Drainage Tube (DWV)
ASTM B370	(2022) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B584	(2022) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B813	(2024) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B828	(2023) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM C564	(2020a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2018; R 2024) Standard Specification for Elastomeric Joint Sealants
ASTM C1053	(2000; R 2010) Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM D1785	(2021) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2000	(2018; R 2024) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2235	(2004; R 2016) Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D2239	(2012) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASTM D2241	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2464	(2015) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	(2023) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2661	(2014; E 2018) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40, Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2665	(2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2672	(2014) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D2683	(2020) Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D2737	(2012a) Polyethylene (PE) Plastic Tubing
ASTM D2846/D2846M	(2019) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D2855	(2020) Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
ASTM D2996	(2023) Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D3035	(2022) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

	Diameter
ASTM D3122	(1995; R 2009) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D3138	(2004; R 2016) Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
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 D3261	(2016) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D4101	(2017) Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
ASTM D4586/D4586M	(2007; R 2018) Asphalt Roof Cement, Asbestos-Free
ASTM E1	(2014) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F437	(2024) Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F438	(2023) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F439	(2024) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F441/F441M	(2023) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F442/F442M	(2023) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASTM F493	(2022) Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F628	(2024) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
ASTM F877	(2024) Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
ASTM F891	(2024) 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
ASTM F2389	(2024a) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2018) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2012) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(2016; 14/17) Copper Tube Handbook
-----------	------------------------------------

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO PS 117	(2021) Press Connections
--------------	--------------------------

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	(2024) 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-44	(2019) Steel Pipeline Flanges
MSS SP-58	(2018) Pipe Hangers and Supports -

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Materials, Design and Manufacture,
Selection, Application, and Installation

MSS SP-67	(2022) Butterfly Valves
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends
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
MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(2025) Class 3000 Steel Pipe Unions Socket Welding and Threaded
MSS SP-85	(2011) Gray Iron Globe & Angle Valves Flanged and Threaded Ends
MSS SP-91	(2009) Guidelines for Manual Operation of Valves
MSS SP-110	(2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(2021) Motors and Generators
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2024) National Fuel Gas Code
NFPA 90A	(2024) Standard for the Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 372	(2022) Drinking Water System Components - Lead Content
NSF/ANSI 14	(2023) Plastics Piping System Components and Related Materials
NSF/ANSI/CAN 61	(2024) Drinking Water System Components -

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

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

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (2010) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (2023) Hose Clamp Specifications

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star (1992; R 2006) Energy Star Energy
Efficiency Labeling System (FEMP)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

PL 93-523 (1974; A 1999) Safe Drinking Water Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 430 Energy Conservation Program for Consumer
Products

21 CFR 175 Indirect Food Additives: Adhesives and
Components of Coatings

40 CFR 141.80 National Primary Drinking Water
Regulations; Control of Lead and Copper;
General Requirements

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 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

Plumbing System;

SD-03 Product Data

Backflow Prevention Assemblies;

Recycled Content for Steel Pipe; S

Recycled Content for Cast Iron Pipe; S

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Water Heaters;

Energy Star Label for Gas Storage Water Heater; S

Energy Star Label for Gas Instantaneous Water Heater; S

Pumps; _____

Welding

Vibration-Absorbing Features; _____

Plumbing System

Thermostatic Mixing Valves

Point-Of-Use Mixing Valve

Automatic Temperature And/Or Pressure Compensating Valve

SD-06 Test Reports

Tests, Flushing and Disinfection

Test of Backflow Prevention Assemblies; _____.

SD-07 Certificates

Materials and Equipment

Bolts

SD-10 Operation and Maintenance Data

Plumbing System;

1.3 SHOP DRAWINGS

Submit Plumbing System 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. Submit Plumbing System 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 must indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details must include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, must be drawn to scale.

1.4 STANDARD PRODUCTS

Specified materials and equipment must be standard products of a

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation must conform to the code and a certificate must be submitted for the equipment.

1.4.1 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 manufacturer's factory or laboratory tests, can be shown.

1.4.2 Service Support

The equipment items must 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 must 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.

1.4.3 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.

1.4.4 Modification of References

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.

1.4.4.1 Definitions

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

1.4.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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, must be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.5 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.

1.6 PERFORMANCE REQUIREMENTS

1.6.1 Welding

Piping must be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Submit a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. Procedures and welders must be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.9, unless temperature and pressure limits specified then may be accepted as permitted by ASME B31.1. The Contracting Officer must be notified 24 hours in advance of tests, and the tests must be performed at the work site if practicable. Welders or welding operators must apply their assigned symbols near each weld they make as a permanent record. Structural members must be welded in accordance with Section 05 05 23.16 STRUCTURAL WELDING.

1.6.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems must be in accordance with Section 26 42 13 GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM

???

1.7 REGULATORY REQUIREMENTS

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

1.8 PROJECT/SITE CONDITIONS

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

1.9 INSTRUCTION TO GOVERNMENT PERSONNEL

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 must be thoroughly familiar with all

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

parts of the installation and must be trained in operating theory as well as practical operation and maintenance work. Submit Plumbing System Operation and Maintenance Data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

Instruction must 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 must 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.

1.10 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 must be in accordance with TABLES I and II.

Cement pipe must contain recycled content as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Pipe schedules must be selected based on service requirements. Pipe fittings must be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement must meet NSF/ANSI 14 and must be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service must bear the NSF seal "NSF-PW." Polypropylene pipe and fittings must conform to dimensional requirements of Schedule 40, Iron Pipe size and must comply with NSF/ANSI 14, NSF/ANSI/CAN 61 and ASTM F2389. Polypropylene piping that will be exposed to UV light must be provided with a Factory applied UV resistant coating. Pipe threads (except dry seal) must conform to ASME B1.20.1. Grooved pipe couplings and fittings must be from the same manufacturer. Material or used in any potable water system intended for human consumption be certified in accordance with NSF 372 with the exception of brazing materials. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers must comply with PL 93-523 and NSF/ANSI/CAN 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI/CAN 61, Section 9. Hubless cast-iron soil pipe must not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors (for Air Force/Army/Navy projects). Plastic pipe must not be installed in air plenums. Plastic pipe must not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe must not be used underground. Solder containing lead must not be used with copper pipe.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Cast iron soil pipe and fittings must be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials must conform to the following:

<OLG>

<OLI>Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310.</OLI>

<OLI>Coupling for Steel Pipe: AWWA C606.</OLI>

<OLI>Couplings for Grooved Pipe: Ductile Iron ASTM A536 (Grade 65-45-12). Copper ASTM B584.</OLI>

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

<OLI>Brazing Material: Brazing material must conform to AWS A5.8/A5.8M, BCuP-5.</OLI>

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

<OLI>Solder Material: Solder metal must conform to ASTM B32.</OLI>

<OLI>Solder Flux: Flux must be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.</OLI>

<OLI>PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.</OLI>

<OLI>Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564.</OLI>

<OLI>Rubber Gaskets for Grooved Pipe: ASTM D2000, maximum temperature 230 degrees F.</OLI>

<OLI>Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.</OLI>

<OLI>Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A183.</OLI>

<OLI>Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D3138.</OLI>

<OLI>Plastic Solvent Cement for ABS Plastic Pipe: ASTM D2235.</OLI>

<OLI>Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.</OLI>

<OLI>Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F493.</OLI>

<OLI>Flanged fittings including, but not limited to, flanges, bolts, nuts and bolt patterns must be in accordance with ASME B16.5 class 150 and must have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material must conform to ASTM A105/A105M. Blind flange material must

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts must be high strength or intermediate strength with material conforming to ASTM A193/A193M. Submit written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.</OLI>

<OLI>Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D3122.</OLI>

<OLI>Press fittings for Copper Pipe and Tube: Copper press fittings must conform to the material and sizing requirements of ASME B16.51 and performance criteria of IAPMO PS 117. Sealing elements for copper press fittings must be EPDM, FKM or HNBR. Sealing elements must be factory installed or an alternative supplied fitting manufacturer. Sealing element must be selected based on manufacturer's approved application guidelines. Provide manufacturer data to show product has been installed on multiple projects of similar type.</OLI>

<OLI>Copper tubing must conform to ASTM B88, Type K, L or M.</OLI>

<OLI>Heat-fusion joints for polypropylene piping: ASTM F2389.</OLI>
</OLG>

2.1.2 Miscellaneous Materials

Miscellaneous materials must conform to the following:

<OLG>

<OLI>Water Hammer Arrestor: PDI WH 201. Water hammer arrester must be diaphragm type.</OLI>

<OLI>Copper, Sheet and Strip for Building Construction: ASTM B370.</OLI>

<OLI>Asphalt Roof Cement: ASTM D4586/D4586M.</OLI>

<OLI>Hose Clamps: SAE J1508.</OLI>

<OLI>Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.</OLI>

<OLI>Hypochlorites: AWWA B300.</OLI>

<OLI>Liquid Chlorine: AWWA B301.</OLI>

<OLI>Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.</OLI>

<OLI>Thermometers: ASTM E1. Mercury must not be used in thermometers.</OLI>
</OLG>

2.1.3 Pipe Insulation Material

Insulation must 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 must conform to MSS SP-58.

2.3 VALVES

Valves must be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller must be bronze with threaded bodies for pipe and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

solder-type connections for tubing. Valves 3 inches and larger must have flanged iron bodies and bronze trim. Pressure ratings must be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valve actuators for manually operated valves 12 inches and larger must be sized and provided by manufacturer assuming the standard operator input forces listed in MSS SP-91." Valves must conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASME BPVC SEC IV, Part HLW-810: Requirements for Potable-Water Heaters Bottom Drain Valve
Trap Seal Primer Valves	ASSE 1018

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer must have a recessed box, with locking cover. A brass or bronze operating rod must be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat must be provided. Valve rod and seat washer must be removable through the face of the hydrant. The hydrant must have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.2 Outlet Boxes

2.3.2.1 Washer Box

One-piece, recessed, metal box with quarter turn shut-off valves, water hammer arresters 1/2 inch hot and cold supplies, 2 inch drain.

2.3.2.2 Ice Maker Box

One-piece, recessed, metal box with quarter turn shut-off valves, 1/2 inch supply.

2.3.3 Thermostatic Mixing Valves

Each valve must be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element must be of an approved type. The body must be of heavy cast bronze, and interior parts must be brass, bronze, corrosion-resisting steel or copper. The valve must be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets.

2.3.4 Temperature Controlled Mixing Valve

Provide an ASSE 1017 temperature controlled (master mixing valve) to lower temperature per UFC 3-420-01 immediately downstream of the water heater and storage tank as close to the fixture(s) as possible in order to reduce the amount of stored tempered water in the pipes in accordance with ASSE 1017.

2.4 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers must meet the above requirements.

Backflow preventers with intermediate atmospheric vent must conform to ASSE 1012. Reduced pressure principle backflow preventers must conform to ASSE 1013. Hose connection vacuum breakers must conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers must conform to ASSE 1001. Pressure vacuum breaker assembly must conform to ASSE 1020. Air gaps in plumbing systems must conform to ASME A112.1.2.

2.5 DRAINS 2.5.1 NOT USED 2.5.1.1 NOT USED 2.5.2 NOT USED 2.5.3 Area Drains

Area drains must be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain must be circular or square with a 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Drains must be cast iron with manufacturer's standard coating. Grate must be easily lifted out for cleaning. Outlet must be suitable for inside caulked connection to drain pipe. Drains must conform to ASME A112.6.3.2.6 WATER HEATERS

Water heater types and capacities must be as indicated. Each water heater must have replaceable anodes. Each primary water heater must have controls with an adjustable range that includes 90 to 160 degrees F. Each gas-fired water heater and booster water heater must have controls with an adjustable range that includes 120 to 180 degrees F. Hot water systems utilizing recirculation systems must be tied into building off-hour controls. The thermal efficiencies and standby heat losses must conform to TABLE III in PART 3 of this Section for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank must be installed on the cold water supply to each water heater. Expansion tanks must be specifically designed for use on potable water systems and must be rated for 200 degrees F water temperature and 150 psi working pressure. The expansion tank size and acceptance volume must be as indicated.

2.6.1 Automatic Storage Type

Heaters must be complete with control system, temperature gauge, and pressure gauge, and must have ASME rated combination pressure and temperature relief valve.

2.6.1.1 Gas-Fired Type

Gas-fired water heaters must conform to ANSI Z21.10.1/CSA 4.1 when input is 75,000 BTU per hour or less or ANSI Z21.10.3/CSA 4.3 for heaters with input greater than 75,000 BTU per hour. Provide Energy Star labeled gas storage water heater. Provide data identifying Energy Star label for gas storage water heater.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.6.2 Instantaneous Water Heater

Heater must be crossflow design with service water in the coil and hot water in the shell. An integral internal controller must be provided, anticipating a change in demand so that the final temperature can be maintained under all normal load conditions when used in conjunction with pilot-operated temperature control system. Normal load conditions must be as specified by the manufacturer for the heater. Unit must be manufactured in accordance with ASME BPVC SEC VIII D1, and must be certified for 150 psi working pressure in the shell and 150 psi working pressure in the coils. Shell must be carbon steel with copper lining. Heads must be bronze. Coils must be copper-nickel. Shell must have metal sheathed fiberglass insulation, combination pressure and temperature relief valve, and thermometer. Insulation must be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. For gas service, provide Energy Star labeled gas instantaneous water heater. Provide data identifying Energy Star label for gas instantaneous water heater.

2.6.3 Electric Instantaneous Water Heaters (Tankless)

UL 499 and UL listed flow switch activated, tankless electric instantaneous water heater for wall mounting below sink or lavatory. Temperature rise at Flow Rate: as indicated on drawings.

2.6.4 Phenolic Resin Coatings for Heater Tubes

The phenolic resin coating system must be applied at either the coil or coating manufacturer's factory in accordance with manufacturer's standard proven production process. The coating system must be a product specifically intended for use on the material the water heating tubes/coils are made of and must be acceptable for use in potable water systems. The coating system must be capable of withstanding temperatures up to 400 degrees F dry bulb; and meet the requirements of 21 CFR 175.

The entire exterior surface of each coil must be coated with phenolic resin coating system.

2.6.4.1 Standard Product

Provide a phenolic resin coating system that is a standard product of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design, and workmanship.

Standard products are defined as components and equipment that have been in satisfactory commercial or industrial use in similar applications of similar size for at least 2 years before bid opening. Prior to this 2 year period, these standard products were sold on the commercial market using advertisements in manufacturers' catalogs or brochures. These manufacturers' catalogs, or brochures must have been copyrighted documents or be identified with a manufacturer's document number.

2.6.4.2 Expansion Tank

Provide a potable water expansion tank of steel construction with a NSF/ANSI/CAN 61 Butyl diaphragm separating the air chamber from the water containing container. Tank must have a stainless steel inlet connector. Diaphragm must be FDA approved. Maximum operating temperature 200 degrees F, Maximum Working Pressure: 150 PSIG (10.3 bar).

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.7 HOT-WATER STORAGE TANKS

Hot-water storage tanks must be constructed by one manufacturer, ASME stamped for the working pressure, and must have the National Board (ASME) registration. The specification AWWA D100 provides standards for water storage tanks, not domestic hot water storage tanks under domestic water pressure. The statement prior describes the tanks being ASME, it must be ASME BPVC (Boiler and Pressure Vessel Code), stamped for working pressure. The two statements combined describe a hot water storage tank under domestic water pressure. The tank must be cement-lined or glass-lined steel type in accordance with AWWA D100. The heat loss must conform to TABLE III in PART 3 of this Section as determined by the requirements of ASHRAE 90.1 - IP. Each tank must be equipped with a thermometer, conforming to ASTM E1, Type I, Class 3, Range C, style and form as required for the installation, and with 7 inch scale. Thermometer must have a separable socket suitable for a 3/4 inch tapped opening. Tanks must be equipped with a pressure gauge 6 inch minimum diameter face. Insulation must be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity must be as shown. Install hot water storage tanks with access hatches in order to facilitate annual cleaning and inspections.

2.8 PUMPS

2.8.1 Circulating Pumps

Domestic hot water circulating pumps must be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump and motor must be supported by the piping on which it is installed. The shaft must be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze.

2.8.1.1 Circulating Pump Enclosure

Motor must be totally enclosed, fan-cooled and must have sufficient horsepower for the service required. Each pump motor must be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover.

2.8.1.2 Circulating Pump Size and Efficiency

Integral size motors must be premium efficiency type in accordance with NEMA MG 1. Pump motors smaller than 1 hp Fractional horsepower pump motors must have integral thermal overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards must shield exposed moving parts.

2.8.2 Flexible Connectors

Flexible connectors must be provided at the suction and discharge of each pump that is 1 hp or larger. Connectors must be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors must be line size and suitable for the pressure and temperature of the intended service.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.9 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, corresponding to the applications in accordance with NEMA MG 11. 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.

2.9.1 Electrical Requirements for Motors

Motors must be rated for continuous duty with the enclosure specified. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. 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 the enclosure.

2.9.2 Electrical Requirements for Controllers and Contactors

Controllers and contactors must have auxiliary contacts for use with the controls provided. 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. For packaged equipment, the manufacturer must provide controllers, including the required monitors and timed restart.

2.9.3 Electrical Requirements for Power Wiring

Power wiring and conduit for field installed equipment must be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.10 MISCELLANEOUS PIPING ITEMS

2.10.1 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where supply drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor. For multiple pipe penetrations through load bearing masonry or concrete walls, minimum spacing must be 6" inches center of pipe to center of pipe.

2.10.1.1 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.

2.10.1.2 Sleeves Not in Masonry and Concrete

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.10.2 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.

2.10.3 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 must 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

Piping located in air plenums must conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts must be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system must be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Submit diagrams, instructions, and other sheets proposed for posting for Plumbing System. Submit for Plumbing System manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe. Water and drainage piping must be extended 5 feet outside the building, unless otherwise indicated. A full port ball valve and drain must be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping must be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes must be laid in separate trenches, except when otherwise shown. Exterior underground utilities must be at least 12 inches below the average local frost depth 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 must be marked with a stake or other acceptable means. Valves must be installed with control no lower than the valve body. Avoid the use of combination double wye and one-eighth bend fittings in the horizontal orientation below grade or below slab.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping must be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system must be arranged and installed to

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, must be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices must be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work must be carefully laid out in advance, and unnecessary cutting of construction must be avoided. Damage to building, piping, wiring, or equipment as a result of cutting must be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings must be closed with caps or plugs during installation. Fixtures and equipment must be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment must be thoroughly cleaned, adjusted, and operated. Safety guards must be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping must be installed as indicated. Pipe must be accurately cut and worked into place without springing or forcing. Structural portions of the building must not be weakened. Aboveground piping must run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings must be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines must not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe must not be buried in or under floors unless specifically indicated or approved. Buried domestic waste vent piping must not be less than 2 inch diameter. Changes in pipe sizes must be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction must 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 must be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated must consist of 3/4 inch hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps must be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance must be made throughout for expansion and contraction of water

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

pipe. Each hot-water and hot-water circulation riser must have expansion loops or other provisions such as offsets and changes in direction where indicated and required. Risers must be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers must be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length must be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility must be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility must be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters must be provided on hot- and cold-water supplies and must be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, must be accessible by means of access doors or removable panels. Commercial-type water hammer arresters must conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings must 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 must be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

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

3.1.2.2 Mechanical Couplings

Mechanical couplings may be used in conjunction with grooved pipe for aboveground, ferrous or non-ferrous, domestic hot and cold water systems, in lieu of unions, brazed, soldered, welded, flanged, or threaded joints.

3.1.2.2.1 Mechanical Coupling Permissibility

Mechanical couplings are permitted in accessible locations including behind access plates. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints must incorporate an angle bolt pad design which maintains metal-to-metal contact with equal amount of pad offset of housings upon installation to ensure positive rigid clamping of the pipe. Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications will not be permitted.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.2.2.2 Grooved Fittings and Couplings

Grooved fittings and couplings, and grooving tools must be provided from the same manufacturer. Segmentally welded elbows must not be used. Grooves must be prepared in accordance with the coupling manufacturer's latest published standards. Grooving must be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations. The Contracting Officer must be notified 24 hours in advance of test to demonstrate operator's capability, and the test must be performed at the work site, if practical, or at a site agreed upon. The operator must demonstrate the ability to properly adjust the grooving tool, groove the pipe, and to verify the groove dimensions in accordance with the coupling manufacturer's specifications.

3.1.2.3 Unions and Flanges

Unions, flanges and mechanical couplings must not be concealed in walls, ceilings, or partitions. Unions must be used on pipe sizes 2-1/2 inches and smaller; flanges must be used on pipe sizes 3 inches and larger.

3.1.2.4 Grooved Mechanical Joints

Grooves must be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools must be products of the same manufacturer. 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. Grooved joints must not be used in concealed locations.

3.1.2.5 Copper Tube and Pipe

<OLG>

<OLI>Brazed. Brazed joints must be made in conformance with AWS B2.2/B2.2M, ASME B16.50, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints must include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) must include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.</OLI>

<OLI>Soldered. Soldered joints must be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints must conform to ASME B31.5 and CDA A4015. Soldered joints must not be used in compressed air piping between the air compressor and the receiver.</OLI>

<OLI>Copper Tube Extracted Joint. Mechanically extracted joints must be made in accordance with ICC IPC.</OLI>

<OLI>Press connection. Copper press connections must be made in **strict** accordance with the manufacturer's installation instructions for manufactured rated size. The joints must be pressed using the tool(s) approved by the manufacturer **of that joint**. Minimum distance between fittings must be in accordance with the manufacturer's requirements.</OLI></OLG>

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.2.6 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe must have joints made with solvent cement. PVC and CPVC pipe must have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe must be made with dielectric unions or flange waterways. Dielectric waterways must have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways must have metal connections on both ends suited to match connecting piping. Dielectric waterways must be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges must meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe must be made with transition fitting for the specific purpose.

3.1.4 Pipe Sleeves and Flashing

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

3.1.4.1 Sleeve Requirements

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

<OLG>

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

<OLI>A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals must consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links must be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt must cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly must be sized as recommended by the manufacturer to fit the pipe and sleeve involved.</OLI>

<OLI>Sleeves must not be installed in structural members, except where indicated or approved. Rectangular and square openings must be as detailed. Each sleeve must extend through its respective floor, or roof, and must 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 must extend a minimum of 4 inches above the finished floor.</OLI>

<OLI>Unless otherwise indicated, sleeves must 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

and concrete slab on grade floors must 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.</OLI>

<OLI>Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, must be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve must not be sealed for interior walls which are not designated as fire rated.</OLI>

<OLI>Sleeves through below-grade walls in contact with earth must be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve must be filled with backing material and sealants in the joint between the pipe and masonry wall as specified above. Sealant selected for the earth side of the wall must be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls must conform to the requirements in Section 07 84 00 FIRESTOPPING.</OLI>
</OLG>

3.1.4.2 Pipe Penetrations

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

3.1.5 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal must be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.6 Supports

3.1.6.1 General

Hangers used to support piping 2 inches and larger must be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors must 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 must 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 must be used where each pipe crosses the base support member. Spacing of the base support members must not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods must not be formed or bent.

3.1.6.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves must be supported and braced to resist seismic loads as specified in Section 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS and as shown. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, must be provided. Material used for supports must be as specified in Section 05 12 00 STRUCTURAL STEEL.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.6.3 Pipe Hangers, Inserts, and Supports

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

<OLG>

<OLI>Types 5, 12, and 26 must not be used.</OLI>

<OLI>Type 3 must not be used on insulated pipe.</OLI>

<OLI>Type 18 inserts must 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.</OLI>

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

<OLI>Type 20 attachments used on angles and channels must be furnished with an added malleable-iron heel plate or adapter.</OLI>

<OLI>Type 24 may be used only on trapeze hanger systems or on fabricated frames.</OLI>

<OLI>Type 39 saddles must be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles must be welded to the pipe.</OLI>

<OLI>Type 40 shields must:</OLI>

<OLI LEVEL="2">Be used on insulated pipe less than 4 inches.</OLI>

<OLI LEVEL="2">Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.</OLI>

<OLI LEVEL="2">Have a high density insert for all pipe sizes. High density inserts must have a density of 8 pcf or greater.</OLI>

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

<OLI>Vertical pipe must 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 must include allowances for expansion and contraction.</OLI>

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

<OLI LEVEL="2">On pipe 4 inches and larger when the temperature of the

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.</OLI>

<OLI LEVEL="2">On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.</OLI>

<OLI LEVEL="2">On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.</OLI>

<OLI>Pipe hangers on horizontal insulated pipe must be the size of the outside diameter of the insulation. The insulation must be continuous through the hanger on all pipe sizes and applications.</OLI>

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

</OLI>

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

</OLG>

3.1.6.4 Structural Attachments

Attachment to building structure concrete and masonry must be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors must be applied with a safety factor not less than 5. Supports must not be attached to metal decking. Supports must 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 must be constructed of ferrous materials only.

3.1.7 Welded Installation

Plumbing pipe weldments must be as indicated. Changes in direction of piping must be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings must be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld must conform to ASME B31.1. Weld defects must be removed and repairs made to the weld, or the weld joints must be entirely removed and rewelded. After filler metal has been removed from its original package, it must be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating must not be used.

3.1.8 Pipe Cleanouts

Pipe cleanouts must be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe must consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug must be caulked into the hub of the fitting and must be flush with the floor. Cleanouts in connection with other pipe, where indicated, must

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs must be installed in plastic pipe. Plugs must be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug must be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions must be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers must be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls must have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic must be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws must not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads must be cast iron.

3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Relief Valves

No valves must be installed between a relief valve and its water heater or storage tank. The P&T relief valve must be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve must be installed directly in a tapping in the tank or heater; otherwise, the P&T valve must be installed in the hot-water outlet piping. A vacuum relief valve must be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

3.2.2 Installation of Gas- and Oil-Fired Water Heater

Installation must conform to NFPA 54 for gas fired and NFPA 31 for oil fired. Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers must be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 24 inches just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

3.2.3 Heat Traps

Piping to and from each water heater and hot water storage tank must be routed horizontally and downward a minimum of 24 inches before turning in an upward direction.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2.4 Connections to Water Heaters

Connections of metallic pipe to water heaters must be made with dielectric unions or flanges. Use of dielectric nipples is prohibited unless internally lined and specifically designed to limit current flow between dissimilar metals.

3.2.5 Expansion Tank

A pre-charged expansion tank must be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor must adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.3 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, must be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Submit details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications. Each foundation must include an adequate number of standard isolation units. Each unit must consist of machine and floor or foundation fastening, together with intermediate isolation material, and must be a standard product with printed load rating. Piping connected to mechanical equipment must be provided with flexible connectors. Isolation unit installation must limit vibration to 10 percent of the lowest equipment rpm.

3.4 IDENTIFICATION SYSTEMS

3.4.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number must be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags must be 1-3/8 inch minimum diameter, and marking must be stamped or engraved. Indentations must be black, for reading clarity. Tags must be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.4.2 Pipe Color Code Marking

Color code marking of piping must be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.4.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme must be provided in buildings having suspended grid ceilings. The color coding scheme must identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components must include valves, dampers, switches, linkages and thermostats. The color coding scheme must consist of a color code board and colored metal disks. Each colored metal disk must be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners must be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners must be manually removable without tools and must not separate from the ceiling panels when panels are dropped from ceiling height. Installation of

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

colored metal disks must follow completion of the finished surface on which the disks are to be fastened. The color code board must have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board must be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols must be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board must be mounted and located in the mechanical or equipment room. The color code system must be as indicated below:

Color	System	Item	Location

3.5 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.5.1 Painting of New Equipment

New equipment painting must be factory applied or shop applied, and must be as specified herein, and provided under each individual section.

3.5.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with ASTM B117, and for that test the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment must not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system must be designed for the temperature service.

3.5.1.2 Shop Painting Systems for Metal Surfaces

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 metal surfaces subject to temperatures in excess of 120 degrees F must be cleaned to bare metal.

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. Color of finish coat must be aluminum or light gray.

<OLG>

<OLI>Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F must receive

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.</OLI>

<OLI>Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F must receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.</OLI>

<OLI>Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F must receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.</OLI>

</OLG>

3.6 TESTS, FLUSHING AND DISINFECTION

Submit 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 must indicate the final position of controls.

3.6.1 Plumbing System

The following tests must be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test must include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure and reasons for choosing this option in lieu of the smoke test to the Contracting Officer for approval.

<OLG>

<OLI>Drainage and Vent Systems Test. The final test must include a smoke test.</OLI>

<OLI>Building Sewers Tests.</OLI>

<OLI>Water Supply Systems Tests.</OLI>

</OLG>

3.6.1.1 Test of Backflow Prevention Assemblies

Certification of proper operation must be submitted and must be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor must have the manufacturer's representative test the device to ensure the unit is properly installed and performing as intended. The Contractor must provide written documentation of the tests performed and signed by the individual performing the tests. Backflow prevention assembly must be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges must be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges must be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly must include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit must be repaired and retested.

3.6.1.2 Shower Pans

After installation of the pan and finished floor, the drain must be temporarily plugged below the weep holes. The floor area must be flooded with water to a minimum depth of 1 inch for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

3.6.2 Defective Work

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

3.6.3 System Flushing

3.6.3.1 During Flushing

Before operational tests or disinfection, potable water piping system must be flushed with potable water. Sufficient water must be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) must specify the number of fixtures to be operated during flushing. Contractor must provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor must be responsible for any flood damage resulting from flushing of the system. Flushing must be continued until entrained dirt and other foreign materials have been removed and until discharge

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI/CAN 61, Section 9, must be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.6.3.2 After Flushing

System must be drained at low points. Strainer screens must be removed, cleaned, and replaced. After flushing and cleaning, systems must be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system must be repaired by the Contractor. When the system flushing is complete, the hot-water system must be adjusted for uniform circulation. Flushing devices and automatic control systems must be adjusted for proper operation according to manufacturer's instructions. Flow rates on fixtures must not exceed those stated in PART 2 of this Section. Unless more stringent local requirements exist, lead levels must not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building must be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.6.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor must subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests must cover a period of not less than 8 hours for each system and must include the following information in a report with conclusion as to the adequacy of the system:

<OLG>

<OLI>Time, date, and duration of test.</OLI>

<OLI>Operation of each valve, hydrant, and faucet.</OLI>

<OLI>Pump suction and discharge pressures.</OLI>

<OLI>Temperature of each domestic hot-water supply.</OLI>

<OLI>Operation of each floor and roof drain by flooding with water.</OLI>

<OLI>Operation of each vacuum breaker and backflow preventer.</OLI>

<OLI>Complete operation of each water pressure booster system, including pump start pressure and stop pressure.</OLI>

</OLG>3.6.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system must be disinfected. Before introducing disinfecting chlorination material, entire system must be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure must be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material must be hypochlorites or liquid chlorine. The

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

chlorinating material must be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

3.6.5.1 Water Chlorination Monitoring

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet must be opened and closed several times. After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

3.6.5.2 Water Chlorination Flushing

Upon the specified verification, the system including tanks must then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet must be opened and closed several times.

3.6.5.3 Sample Testing

Take additional samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer. Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method used must be EPA approved for drinking water systems and must comply with applicable local and state requirements.

3.6.5.4 Disinfection Acceptance

Disinfection must be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.7 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, must be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system must be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions must be posted before acceptance testing of the systems.

3.8 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

DP = Draw pattern

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 70 degrees F delta T.

SL = Standby loss is maximum (Btu/h) based on a 70 degrees F temperature difference between stored water and ambient requirements.

UEF = Uniform energy factor

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

3.8.1 Storage Water Heaters

3.8.1.1 Gas

<OLG>

<OLI>Storage capacity more than or equal to 20 gallons and less than or equal to 55 gallons with a draw pattern (DP) of: very small must have a uniform energy factor (UEF) of 0.3456 - $(0.0020 \times V)$, low must have a uniform energy factor (UEF) of 0.5982 - $(0.0019 \times V)$, medium must have a uniform energy factor (UEF) of 0.6483 - $(0.0017 \times V)$, high must have a uniform energy factor (UEF) of 0.6920 - $(0.0013 \times V)$ per 10 CFR 430.</OLI>

<OLI>Storage capacity more than 55 gallons and less than or equal to 100 gallons with a draw pattern (DP) of: very small must have a uniform energy factor (UEF) of 0.6470 - $(0.0006 \times V)$, low must have a uniform energy factor (UEF) of 0.7689 - $(0.0005 \times V)$, medium must have a uniform energy factor (UEF) of 0.7897 - $(0.0004 \times V)$, high must have a uniform energy factor (UEF) of 0.8702 - $(0.0003 \times V)$ per 10 CFR 430.</OLI>

<OLI>Storage capacity less than or equal to 120 gallons with input rating more than 75,000 Btu/h and less than 105,000 Btu/h with a draw pattern (DP) of: very small must have a uniform energy factor (UEF) of 0.2674 - $(0.0009 \times V)$, low must have a uniform energy factor (UEF) of 0.5362 - $(0.0012 \times V)$, medium must have a uniform energy factor (UEF) of 0.6002 - $(0.0011 \times V)$, high must have a uniform energy factor (UEF) of 0.6597 - $(0.0009 \times V)$ per 10 CFR 430.</OLI>

</OLG>

3.8.2 Unfired Hot Water Storage

All volumes and inputs: must meet or exceed R-12.5.

3.8.3 Instantaneous Water Heater

3.8.3.1 Gas

<OLG>

<OLI>Storage capacity less than 2 gallons input rating greater than 50,000 Btu/h with a draw pattern (DP) of: very small must have a uniform energy factor (UEF) of 0.80, low must have a uniform energy factor (UEF) of 0.81, medium must have a uniform energy factor (UEF) of 0.81, high must have a uniform energy factor (UEF) of 0.81 per 10 CFR 430.</OLI>

<OLI>Rating of 4,000 Btu/h/gal and storage capacity less than 10 gallons with an input of 200,000 Btu/h must have a minimum thermal efficiency (ET) of 80 percent per ANSI Z21.10.3/CSA 4.3.</OLI>

<OLI>Rating of 4,000 BTU/h/gal and storage capacity more than 10 gallons

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

with an input more than 200,000 Btu/h must have a minimum thermal efficiency (ET) of 80 percent and the maximum SL must be $Q/800+110 \times (V^{1/2})$ per ANSI Z21.10.3/CSA 4.3.

</OLI>

</OLG>3.9 TABLES

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings must be marked with the CISPI trademark.	X	X	X	X	X		
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888. Pipe and fittings must be marked with the CISPI trademark.		X		X	X		
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X			

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X		
5	Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A536 And ASTM A47/A47M	X	X		X	X		
6	Ductile iron grooved joint fittings for ferrous pipe ASTM A536 and ASTM A47/A47M for use with Item 5	X	X		X	X		
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B584, for use with Item 5	X	X		X	X		

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
8	Wrought copper grooved joint pressure fittings for non-ferrous pipe ASTM B75/B75M C12200, ASTM B152/B152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X					
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X		
10	Steel pipe, seamless galvanized, ASTM A53/A53M, Type S, Grade B				X	X		
11	Seamless red brass pipe, ASTM B43				X	X		X
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X		X

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
13	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X		X
14	Seamless copper pipe, ASTM B42						X	X
15	Cast bronze threaded fittings, ASME B16.15				X	X		
16	Copper drainage tube, (DWV), ASTM B306	X*	X	X*	X	X		X
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X		X
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X		X
19	Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D2661, ASTM F628	X	X	X	X	X	X	

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
20	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
21	Process glass pipe and fittings, ASTM C1053						X	
22	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A518/A518M		X			X	X	
23	Polypropylene (PP) waste pipe and fittings, ASTM D4101						X	
24	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D2996						X	
25	Cast Iron pipe and fittings, CEN EN 877 piping	X	X	X	X	X	X	

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
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								

TABLE II						
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS						
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	
1	Malleable-iron threaded fittings:					
	a. Not galvanized for use with Item 4b			X		
2	Grooved pipe couplings, ferrous pipe ASTM A536 and ASTM A47/A47M, non-ferrous pipe, ASTM A536 and ASTM A47/A47M	X	X	X		
3	Ductile iron grooved joint fittings for ferrous pipe ASTM A536 and ASTM A47/A47M, for use with Item 2	X	X	X		

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
4	Steel pipe:				
	a. Seamless, black, ASTM A53/A53M, Type S, Grade B			X	
5	Seamless red brass pipe, ASTM B43	X	X		X
6	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		X
7	Seamless copper pipe, ASTM B42	X	X		X
8	Seamless copper water tube, ASTM B88, ASTM B88M	X**	X**	X**	X***
9	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		X
10	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8	X	X	X	X
11	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 8	X	X	X	X
12	Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B584, for use with Item 2	X	X	X	
13	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter	X			X
14	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D3035	X			X

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
15	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D2239	X			X
16	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D3261 for use with Items 14, 15, and 16	X			X
17	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D2683 for use with Item 15	X			X
18	Polyethylene (PE) plastic tubing, ASTM D2737	X			X
19	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D2846/D2846M	X	X		X
20	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F441/F441M	X	X		X
21	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F442/F442M	X	X		X
22	Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F437 for use with Items 20, and 21	X	X		X
23	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F438 for use with Items 20, 21, and 22	X	X		X

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
24	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F439 for use with Items 20, 21, and 22	X	X		X
25	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D1785	X			X
26	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D2241	X			X
27	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D2466	X			X
28	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2467 for use with Items 26 and 27	X			X
29	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2464	X			X
30	Joints for IPS PVC pipe using solvent cement, ASTM D2672	X			X
31	Polypropylene (PP) plastic pipe and fittings; ASTM F2389	X	X		X
32	Steel pipeline flanges, MSS SP-44	X	X		
33	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B828	X	X		
34	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X	
35	Malleable-iron threaded pipe unions ASME B16.39	X	X		

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
36	Nipples, pipe threaded ASTM A733	X	X	X	
37	Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F877	X	X		X
38	Press Fittings	X	X		
	SERVICE: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground C - Compressed Air Lubricated D - Cold Water Service Belowground Indicated types are minimum wall thicknesses. ** - Type L - Hard *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors **** - In or under slab floors only brazed joints				

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE III					
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT					
<u>FUEL</u>	<u>STORAGE CAPACITY OR RATING CONDITION</u>	<u>INPUT RATING</u>	<u>TEST PROCEDURE</u>	<u>REQUIRED PERFORMANCE</u>	
A. STORAGE WATER HEATERS					
Elect.	>20 gal and ≤55 gal		10 CFR 430	DP	UEF
				Very Small	0.8808 - (0.0008 x V)
				Low	0.9254 - (0.0003 x V)
				Medium	0.9307 - (0.0002 x V)
				High	0.9349 - (0.0001 x V)
Elect.	>55 gal and ≤120 gal		10 CFR 430	DP	UEF
				Very Small	1.9236 - (0.0011 x V)
				Low	2.0440 - (0.0011 x V)
				Medium	2.1171 - (0.0011 x V)
				High	2.2418 - (0.0011 x V)
Elect. Heat Pump		≤24 Amps and ≤250 Volts	10 CFR 430	Rating Condition	UEF
				Integrated heat pump water heater (HPWH)	UEF >3.3 and First Hour Rating ≥45 gal/h
				Integrated HPWH, >120 V/15 Amp Circuit or Split-System HPWH	UEF >2.2 and First Hour Rating ≥45 gal/h
Elect. Heat Pump		>12 kW	10 CFR 430	HPWH COP ≥3.0	

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE III					
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT					
<u>FUEL</u>	<u>STORAGE CAPACITY OR RATING CONDITION</u>	<u>INPUT RATING</u>	<u>TEST PROCEDURE</u>	<u>REQUIRED PERFORMANCE</u>	
Gas	>20 gal and ≤55 gal		10 CFR 430	DP	UEF
				Very Small	0.3456 - (0.0020 x V)
				Low	0.5982 - (0.0019 x V)
				Medium	0.6483 - (0.0017 x V)
				High	0.6920 - (0.0013 x V)
Gas	>55 gal and ≤100 gal		10 CFR 430	DP	UEF
				Very Small	0.6470 - (0.0020 x V)
				Low	0.7689 - (0.0025 x V)
				Medium	0.7897 - (0.0004 x V)
				High	0.8072 - (0.0003 x V)
Gas	≤120 gal	75,000 Btu/h	10 CFR 430	DP	UEF
				Very Small	0.2674 - (0.0009 x V)
				Low	0.5362 - (0.0012 x V)
				Medium	0.6002 - (0.0011 x V)
				High	0.6597 - (0.0009 x V)
Oil	≤50 gal		10 CFR 430	DP	UEF
				Very Small	0.2509 - (0.0012 x V)
				Low	0.5330 - (0.0016 x V)
				Medium	0.6078 - (0.0016 x V)
				High	0.6815 - (0.0014 x V)

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE III					
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT					
FUEL	STORAGE CAPACITY OR RATING CONDITION	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE	
Oil	≤120 gal	>105,000 Btu/h and ≤ 140,000 Btu/h	10 CFR 430	DP	UEF
				Very Small	0.2932 - (0.0015 x V)
				Low	0.5596 - (0.0018 x V)
				Medium	0.6194 - (0.0016 x V)
				High	0.6740 - (0.0013 x V)
B. Unfired Hot Water Storage, R-12.5 min.					
C. Instantaneous Water Heater					
Elect.	<2 gal		10 CFR 430	DP	UEF
				Very Small	0.91
				Low	0.91
				Medium	0.91
				High	0.92
Gas	<2 gal and >50,000 Btu/h		10 CFR 430	DP	UEF
				Very Small	0.80
				Low	0.81
				Medium	0.81
				High	0.81
Gas	4,000 (btu/h)/gal and 10 gal max.	200,000 Btu/h min.	ANSI Z21.10.3/C	ET = 80 percent	
Gas	4,000 (btu/h)/gal and 10 gal max.	200,000 Btu/h min.	ANSI Z21.10.3/C	ET = 80 percent SL = (Q/800+110x(V ^{1/2}))	
Oil	4,000 (btu/h)/gal and 2 gal max.	50,000 Btu/h min. 210,000 Btu/h max.	10 CFR 430	ET = 80 percent and EF = 0.59-0.0005V	

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE III				
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT				
<u>FUEL</u>	<u>STORAGE CAPACITY OR RATING CONDITION</u>	<u>INPUT RATING</u>	<u>TEST PROCEDURE</u>	<u>REQUIRED PERFORMANCE</u>
Oil	4,000 (btu/h)/gal and 10 gal max.	210,000 Btu/h min.	ANSI Z21.10.3/C	ET = 80 percent
Oil	4,000 (btu/h)/gal and 10 gal max.	210,000 Btu/h min.	ANSI Z21.10.3/C	ET = 78 percent SL = $(Q/800 + 110 \times (V^{1/2}))$ max.
D. Pool Heater				
Gas or Oil	All	All	ASHRAE 146	ET = 82 percent
Heat Pump All	All	All	ANSI/AHRI 1160	COP = 4.0
TERMS: DP = Draw Pattern EF = Energy factor, minimum overall efficiency. ET = Minimum thermal efficiency with 70 degrees F delta T. SL = Standby loss is maximum Btu/h based on a 70 degree F temperature difference between stored water and ambient requirements. UEF = Uniform energy factor V = Rated storage volume in gallons Q = Nameplate input rate in Btu/h				

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 03 00.00 20

BASIC MECHANICAL MATERIALS AND METHODS

08/10, CHG 3: 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.

ASTM INTERNATIONAL (ASTM)

ASTM B117 (2019) Standard Practice for Operating
Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2023) National Electrical Safety Code

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 70 (2023; ERTA 1 2024; TIA 24-1) National
Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Divisions: 21, FIRE SUPPRESSION; 22, PLUMBING; and 23, HEATING, VENTILATING, AND AIR CONDITIONING of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use must include applications of equipment and materials under similar circumstances and of similar size. The product must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.3.2 Alternative Qualifications

Products having less than a two-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 or laboratory tests, can be shown.

1.3.3 Service Support

The equipment items must 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 must 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.

1.3.4 Manufacturer's Nameplate

For each item of equipment, provide 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.

1.3.5 Modification of References

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.

1.3.5.1 Definitions

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

1.3.5.2 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, must 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

damaged or defective items.

1.5 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors must conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and must have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work must be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment must be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.6 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations must conform to IEEE C2, NFPA 70, and requirements specified herein.

1.6.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors are not to be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, and the electrical power circuits must be provided under Division 26, except internal wiring for components of package equipment must be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.6.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 26.

1.6.3 High Efficiency Motors

1.6.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors must be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.6.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors must be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings must meet or exceed energy efficient ratings in

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

accordance with Table 12-6C of NEMA MG 1.

1.6.4 Three-Phase Motor Protection

Provide controllers for motors rated one 1 horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

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 must be thoroughly familiar with all parts of the installation and must be trained in operating theory as well as practical operation and maintenance work.

Instruction must 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 must 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

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

Not used.

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting must be factory applied or shop applied, and must be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with ASTM B117, and for that test the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must show no signs of rust creepage

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment must not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system must be designed for the temperature service.

3.1.2 Shop Painting Systems for Metal Surfaces

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 metal surfaces subject to temperatures in excess of 120 degrees F must be cleaned to bare metal.

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. Color of finish coat must be aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F must receive 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 1 mil; and two coats of enamel applied to a minimum dry film thickness of 1 mil per coat.
- b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F must receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.
- c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F must receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 05 15

COMMON PIPING FOR HVAC

05/22, CHG 2: 08/24

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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2017) Steel Construction Manual

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.18.1/CSA B125.1	(2024) Plumbing Supply Fittings
ASME A112.19.2/CSA B45.1	(2024) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME B1.20.7	(1991; R 2013) Standard for Hose Coupling Screw Threads (Inch)
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 B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2024) Factory-Made Wrought Buttwelding Fittings
ASME B16.22	(2021) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.25	(2022) Buttwelding Ends
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 B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASME B31.3	(2024) Process Piping
ASME B40.100	(2022) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME BPVC SEC VIII D1	(2023) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS WHB-2.9	(2004) Welding Handbook; Volume 2, Welding Processes, Part 1

ASTM INTERNATIONAL (ASTM)

ASTM A6/A6M	(2024b) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A126	(2004; R 2023) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A197/A197M	(2020; R 2023; E 2023) Standard Specification for Cupola Malleable Iron
ASTM A234/A234M	(2024) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A276/A276M	(2024) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2023) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A312/A312M	(2022a) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A563	(2021; E 2022a) Standard Specification for Carbon and Alloy Steel Nuts

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASTM A888	(2024) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C67/C67M	(2024) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C109/C109M	(2024) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C404	(2024) Standard Specification for Aggregates for Masonry Grout
ASTM C476	(2023) Standard Specification for Grout for Masonry
ASTM C553	(2024) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C920	(2018; R 2024) Standard Specification for Elastomeric Joint Sealants
ASTM D2000	(2018; R 2024) Standard Classification System for Rubber Products in Automotive Applications
ASTM E1	(2014) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM E84	(2024) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E814	(2024) Standard Test Method for Fire Tests of Penetration Firestop Systems
ASTM F104	(2011; R 2020) Standard Classification System for Nonmetallic Gasket Materials
ASTM F2389	(2024a) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 310	(2012) Coupling for Use in Connection with
-----------	--

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Hubless Cast Iron Soil Pipe and Fittings
for Sanitary and Storm Drain, Waste, and
Vent Piping Applications

FLUID SEALING ASSOCIATION (FSA)

FSA-0017 (1995e6) Standard for Non-Metallic
Expansion Joints and Flexible Pipe
Connectors Technical Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 515 (2017) Standard for the Testing, Design,
Installation, and Maintenance of
Electrical Resistance Heat Tracing for
Industrial Applications

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

MSS SP-67 (2022) Butterfly Valves

MSS SP-70 (2011) Gray Iron Gate Valves, Flanged and
Threaded Ends

MSS SP-72 (2010a) Ball Valves with Flanged or
Butt-Welding Ends for General Service

MSS SP-80 (2019) Bronze Gate, Globe, Angle and Check
Valves

MSS SP-110 (2010) Ball Valves Threaded,
Socket-Welding, Solder Joint, Grooved and
Flared Ends

MSS SP-125 (2010) Gray Iron and Ductile Iron In-Line,
Spring-Loaded, Center-Guided Check Valves

NSF INTERNATIONAL (NSF)

NSF/ANSI 14 (2023) Plastics Piping System Components
and Related Materials

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-18480 (1982; Rev B; Notice 2 2009; Notice 3
2022) Coating Compound, Bituminous,
Solvent, Coal-Tar Base

MIL-DTL-17813 (2009; Rev H; Supp 1 2009; Notice 1 2013;
Notice 2 2018; Notice 3 2023) Expansion
Joints, Pipe, Metallic Bellows, General
Specification for

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1922	(Rev A; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Caulking Anchors, Single Lead)
CID A-A-1923	(Rev A; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	(Rev A; Notice 3) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors)
CID A-A-1925	(Rev A; Notice 1; Notice 2; Notice 3; Notice 4) Shield Expansion (Nail Anchors)
CID A-A-55614	(Basic; Notice 2) Shield, Expansion (Non-Drilling Expansion Anchors)
CID A-A-55615	(Basic; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors)

UL SOLUTIONS (UL)

UL 1479	(2015; Reprint Apr 2024) Fire Tests of Through-Penetration Firestops
---------	--

1.2 GENERAL REQUIREMENTS

- a. Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section
- b. Section 23 05 48.19 SEISMIC BRACING FOR HVAC applies to work specified in this section.
- c. Submit Records of Existing Conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of the existing conditions.
- d. Include with Equipment Foundation Data for piping systems all plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.
- e. Submit Fabrication Drawings for pipes, valves and specialties consisting of fabrication and assembly details to be performed in the factory.
- f. Submit Material, Equipment, and Fixture Lists for pipes, valves and specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. Provide a complete list of construction equipment to be used.
- g. Submit Manufacturer's Standard Color Charts for pipes, valves and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

specialties showing the manufacturer's recommended color and finish selections.

- h. Include with Listing of Product Installations for piping systems identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. Include in the list purchaser, address of installation, service organization, and date of installation.
- i. Submit Record Drawings for pipes, valves and accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.
- j. Submit Connection Diagrams for pipes, valves and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.
- k. Submit Coordination Drawings for pipes, valves and specialties showing coordination of work between different trades and with the structural and architectural elements of work. Detail all drawings sufficiently to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Indicate on drawings where conflicts or clearance problems exist between various trades.

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 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

Material, Equipment, and Fixture Lists;

SD-02 Shop Drawings

Record Drawings;

Connection Diagrams;

Coordination Drawings;

Fabrication Drawings;

Installation Drawings;

SD-03 Product Data

Pipe and Fittings;

Piping Specialties;

Valves;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Miscellaneous Materials;
Supporting Elements;
Equipment Foundation Data;

SD-04 Samples

Manufacturer's Standard Color Charts;

SD-05 Design Data

Pipe and Fittings;
Piping Specialties;
Valves;

SD-06 Test Reports

Hydrostatic Tests;
Air Tests;
Valve-Operating Tests;
Drainage Tests;
Pneumatic Tests;
Non-Destructive Electric Tests;
System Operation Tests;

SD-07 Certificates

Record of Satisfactory Field Operation;
List of Qualified Permanent Service Organizations;
Listing of Product Installations;
Records of Existing Conditions;
Surface Resistance;
Shear and Tensile Strengths;
Temperature Ratings;
Bending Tests;
Flattening Tests;
Transverse Guided Weld Bend Tests;

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4 QUALITY ASSURANCE

1.4.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Provide standard products in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.2 Alternative Qualifications

Products having less than a two-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 or laboratory tests, can be shown.

1.4.3 Service Support

Ensure the equipment items are supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. Select service organizations that are 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.

1.4.4 Manufacturer's Nameplate

Provide a nameplate on each item of equipment bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not acceptable.

1.4.5 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.

1.4.5.1 Definitions

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4.5.2 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, are applied as appropriate by the Contracting Officer and as authorized by his administrative cognizance and the FAR.

1.5 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.

1.6 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Ensure motors, controllers, disconnects and contactors conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors is not permitted. Provide controllers and contactors with a maximum of 120 volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, include the cost of additional electrical service and related work under the section that specified that motor or equipment. Provide power wiring and conduit for field installed equipment under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.7 NOT USED

1.8 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. Provide instructors thoroughly familiar with all parts of the installation and trained in operating theory as well as practical operation and maintenance work.

Give instruction 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 is as specified in the individual section. When more than four 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.9 ACCESSIBILITY

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 NOT USED

2.2 PIPE AND FITTINGS

Submit equipment and performance data for pipe and fittings consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis. Submit design analysis and calculations consisting of surface resistance, rates of flow, head losses, inlet and outlet design, required radius of bend, and pressure calculations. Also include in data pipe size, shape, and dimensions, as well as temperature ratings, vibration and thrust limitations minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

2.2.1 Type BCS, Black Carbon Steel

Ensure pipe 1/8 through 10 inches is Schedule 40 black carbon steel, conforming to ASTM A53/A53M.

Ensure pipe 1/8 through 10 inches is Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A53/A53M, Type E, Grade B (electric-resistance welded) . Grade A should be used for permissible field bending, in both cases.

Ensure fittings 2 inches and under are 150-pounds per square inch, gage (psig) working steam pressure (wsp) banded black malleable iron screwed, conforming to ASTM A197/A197M and ASME B16.3.

Ensure unions 2 inches and under are 250 pounds per square inch, wsp female, screwed, black malleable iron with brass-to-iron seat, and ground joint, conforming to ASME B16.39.

Ensure fittings 2-1/2 inches and over are Steel butt weld, conforming to ASTM A234/A234M and ASME B16.9 to match pipe wall thickness.

Ensure flanges 2-1/2 inches and over are 150-pound forged-steel conforming to ASME B16.5, welding neck to match pipe wall thickness.

2.2.2 NOT USED

Ensure fittings 2 inches and under are 125-psig wsp, cast iron, screwed end, conforming to ASTM A126 Class A and ASME B16.4.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.3 NOT USED

2.2.4 Type GCS-DWV, Galvanized Steel Drain, Waste and Vent

Ensure pipe (all sizes) is Schedule 40 electric-resistance welded galvanized carbon steel, conforming to ASTM A53/A53M, Grade A.

Furnace butt weld pipe is acceptable for sizes less than 2 inches.

Ensure fittings are galvanized, coated, screwed, cast iron, recessed pattern drainage fittings, conforming to ASTM A126.

Use long radius fittings wherever space permits. Short-turn tees, branches, and ells may be used for vent piping and connections of branch lines to battery fixtures, except wall-hung water closets.

2.2.5 Type CISP-DWV, Cast-Iron Drain, Waste and Vent

Provide soil pipe drain, waste, and vent hubless cast iron pipe and fittings, conforming to ASTM A888. Joints shall be heavyweight no-hub couplings with stainless steel clamps, conforming to CISPI 310.

2.2.6 Type CPR, Copper

2.2.6.1 Type CPR-A, Copper Above Ground

Ensure tubing 2 inches and under is seamless copper tubing, conforming to ASTM B88, Type L (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

Ensure fittings 2 inches and under are 150-psig wrought-copper solder joint fittings conforming to ASME B16.22.

Ensure unions 2 inches and under are 150-psig wrought-copper solder joint, conforming to ASME B16.22.

Provide brazing rod with Classification BCuP-5, conforming to AWS A5.8/A5.8M.

2.2.6.2 Type CPR-U, Copper Under Ground

Provide Type K seamless copper tube piping, conforming to ASTM B88. Use wrought copper socket-joint fittings, conforming to ASME B16.22. Ensure fittings for connection to corporation cocks are cast bronze, flared-type, conforming to ASME B16.26. Braze the joints.

2.2.6.3 Type CPR-INS, Copper Under Ground Insulated

Provide insulated Type K seamless copper tube piping conforming to ASTM B88. Use wrought copper socket-joint fittings, conforming to ASME B16.22. Braze the joints.

Provide insulation not less than 2 inches thick, suitable for continuous service temperatures of not less than 250 degrees F. Use factory-molded, closed-cell polyurethane foam insulation of not less than 2.5 pounds per cubic foot density. Waterproof insulation with an extruded rigid Type II

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

virgin polyvinylchloride, with minimum wall thickness of 60 mils through 4 inches outside diameter, 85 mils through 6.625 inches and 110 mils through 12.750 inches. Provide fitting covers fabricated from the same materials and thickness as adjacent pipe covering according to the manufacturer's directions.

2.2.7 Polypropylene Pipe

Pipe is manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F2389. Pipe is made in a three layer extrusion process. Piping contains a fiber layer (faser) to restrict thermal expansion. Pipe complies with the rated pressure requirements of ASTM F2389. Ensure layers are incorporated in the pipe wall to limit thermal expansion to 2 1/4-inches per 100 F per 100-ft. If the hydronic system includes ferrous components, an oxygen barrier is required in pipe wall.

Ensure pipe is certified by NSF International as complying with NSF/ANSI 14, and ASTM F2389.

Ensure pipe wrap or insulation meets the requirements of ASTM E84. Ensure the system has a Flame Spread Classification of less than 25 and Smoke Development rating of less than 50.

Where pipe is exposed to direct UV light for more than 30 days, provide a Factory applied, UV-resistant coating or alternative UV protection.

2.2.8 Grooved Pipe Couplings and Fittings

Provide housing for all couplings, fabricated in two or more parts, of black, ungalvanized malleable iron castings. Ensure coupling gasket is molded synthetic rubber, conforming to ASTM D2000. Ensure coupling bolts are oval-neck, track-head type, with hexagonal heavy nuts conforming to ASTM A183.

Fabricate all pipe fittings used with couplings of black, ungalvanized malleable iron castings. Where a manufacturer's standard-size malleable iron fitting pattern is not available, approved fabricated fittings may be used.

Fabricate fittings from Schedule 40 or 0.75-inch wall ASTM A53/A53M, Grade B seamless steel pipe; long radius seamless welding fittings with wall thickness to match pipe, conforming to ASTM A234/A234M and ASME B16.9.

2.3 PIPING SPECIALTIES

Submit equipment and performance data for piping specialties consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis. Submit design analysis and calculations consisting of surface resistance, rates of flow, head losses, inlet and outlet design, required radius of bend, and pressure calculations. Also include in data pipe size, shape, and dimensions, as well as temperature ratings, vibration and thrust limitations minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

2.3.1 Air Separator

Air separated from converter discharge water is ejected by a reduced-velocity device vented to the compression tank.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Ensure the air separator is carbon steel, designed, fabricated, tested, and stamped in conformance with ASME BPVC SEC VIII D1 for service pressures not less than 125 psi.

2.3.2 Air Vents

Provide manual air vents using 3/8-inch globe valves.

Provide automatic air vents on pumps, mains, and where indicated using ball-float construction. Ensure the vent inlet is not less than 3/4-inch ips and the outlet not less than 1/4-inch ips. Orifice size is 1/8 inch. Provide corrosion-resistant steel trim conforming to ASTM A276/A276M. Fit vent with try-cock. Ensure vent discharges air at any pressure up to 150 psi. Ensure outlet is copper tube routed.

2.3.3 Compression Tank

Provide compression tank designed, fabricated, tested, and stamped for a working pressure of not less than 125 psi in accordance with ASME BPVC SEC VIII D1. Ensure tank is hot-dip galvanized after fabrication to produce not less than 1.5 ounces of zinc coating per square foot of single-side surface.

Tank accessories include red-lined gage-glass complete with glass protectors and shutoff valves, air charger and drainer, and manual vent.

2.3.4 Dielectric Connections

Electrically isolate dissimilar pipe metals from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

2.3.5 Expansion Vibration Isolation Joints

Construct single or multiple arch-flanged expansion vibration isolation joints of steel-ring reinforced chloroprene-impregnated cloth materials. Design joint to absorb the movement of the pipe sections in which installed with no detrimental effect on the pipe or connected equipment. Back flanges with ferrous-metal backing rings. Provide control rod assemblies to restrict joint movement. Coat all nonmetallic exterior surfaces of the joint with chlorosulphonated polyethylene. Provide grommets in limit bolt hole to absorb noise transmitted through the bolts.

Ensure joints are suitable for continuous-duty working temperature of at least 250 degrees F.

Fill arches with soft chloroprene.

Ensure joint, single-arch, movement limitations and size-related, pressure characteristics conform to FSA-0017.

2.3.6 Flexible Pipe

Construct flexible pipe vibration and pipe-noise eliminators of wire-reinforced, rubber-impregnated cloth and cord materials and be flanged. Back the flanges with ferrous-metal backing rings. Ensure service pressure-rating is a minimum 1.5 times actual service, with surge

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

pressure at 180 degrees F.

Construct flexible pipe vibration and pipe noise eliminators of wire-reinforced chloroprene-impregnated cloth and cord materials. Ensure the pipe is flanged. Provide all flanges backed with ferrous-metal backing rings. Coat nonmetallic exterior surfaces of the flexible pipe with an acid- and oxidation-resistant chlorosulphonated polyethylene. Rate the flexible pipe for continuous duty at 130 psi and 250 degrees F.

Ensure unit pipe lengths, face-to-face, are not less than the following:

<u>INSIDE DIAMETER</u>	<u>UNIT PIPE LENGTH</u>
To 2-1/2 inches, inclusive	12 inches
3 to 4 inches, inclusive	18 inches
5 to 12 inches, inclusive	24 inches

2.3.7 Flexible Metallic Pipe

Ensure flexible pipe is the bellows-type with wire braid cover and designed, constructed, and rated in accordance with the applicable requirements of ASME B31.3.

Minimum working pressure rating is 50 psi at 300 degrees F.

Ensure minimum burst pressure is four times working pressure at 300 degrees F. Bellows material is AISI Type 316L corrosion-resistant steel. Ensure braid is AISI 300 series corrosion-resistant steel wire.

Provide threaded end connections; hex-collared Schedule 40, AISI Type 316L corrosion-resistant steel, conforming to ASTM A312/A312M.

2.3.8 NOT USED

2.3.9 Metallic Expansion Joints

Provide metallic-bellows expansion joints conforming to MIL-DTL-17813.

Design and construct joints to absorb all of the movements of the pipe sections in which installed, with no detrimental effect on pipe or supporting structure.

Rate, design, and construct joints for pressures to 125 psig and temperatures to 500 degrees F.

Ensure joints have a designed bursting strength in excess of four times their rated pressure.

Ensure joints are capable of withstanding a hydrostatic test of 1.5 times their rated pressure while held at their uncompressed length without leakage or distortion that may adversely affect their life cycle.

Ensure life expectancy is not less than 10,000 cycles.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Ensure movement capability of each joint exceeds calculated movement of piping by 100 percent.

Provide bellows and internal sleeve material of AISI Type 304, 304L, or 321 corrosion-resistant steel.

End connections require no field preparation other than cleaning.

Butt weld end preparation of expansion joints conform to the same codes and standards requirements as applicable to the piping system materials at the indicated joint location.

Provide joints, 2-1/2 inches and smaller, with internal guides and limit stops.

Provide joints, 3 inches and larger, with removable external covers, internal sleeves, and purging connection. Size sleeves to accommodate lateral clearance required, with minimum reduction of flow area, and with oversized bellows where necessary. When a sleeve requires a gasket as part of a locking arrangement, provide the gasket used by the manufacturer. Joints without purging connection may be provided; however, remove these from the line prior to, or not installed until, cleaning operations are complete.

Provide the cylindrical end portion of the reinforced bellows element with a thrust sleeve of sufficient thickness to bring that portion within applicable code-allowable stress. Provide 360 degrees support for the element and end-reinforcing ring with the sleeve.

Ensure each expansion joint has adjustable clamps or yokes provided at quarter points, straddling the bellows. Overall joint length is set by the manufacturer to maintain joints in manufacturer's recommended position during installation.

Permanently and legibly mark each joint with the manufacturer's name or trademark and serial number; the size, series, or catalog number; bellows material; and directional-flow arrow.

2.3.10 Hose Faucets

Construct hose faucets with 1/2 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection, conforming to ASME A112.18.1/CSA B125.1. Ensure hose-coupling screw threads conform to ASME B1.20.7.

Provide vandal proof, atmospheric-type vacuum breaker on the discharge of all potable water lines.

2.3.11 Pressure Gages

Ensure pressure gages conform to ASME B40.100 and to requirements specified herein. Pressure-gage size is 3-1/2 inches nominal diameter. Ensure case is corrosion-resistant steel, conforming to any of the AISI 300 series of ASTM A6/A6M, with an ASM No. 4 standard commercial polish or better. Equip gages with adjustable red marking pointer and damper-screw adjustment in inlet connection. Align service-pressure reading at midpoint of gage range. Ensure all gages are Grade B or better and be equipped with gage isolators.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.3.12 NOT USED

2.3.13 Sleeve Couplings

Sleeve couplings for plain-end pipe consist of one steel middle ring, two steel followers, two chloroprene or Buna-N elastomer gaskets, and the necessary steel bolts and nuts.

2.3.14 Thermometers

Ensure thermometers conform to ASTM E1, except for being filled with a red organic liquid. Provide an industrial pattern armored glass thermometer, (well-threaded and seal-welded). Ensure thermometers installed 6 feet or higher above the floor have an adjustable angle body. Ensure scale is not less than 7 inches long and the case face is manufactured from manufacturer's standard polished aluminum or AISI 300 series polished corrosion-resistant steel. Thermometer range is 100 degrees. Provide thermometers with nonferrous separable wells. Provide lagging extension to accommodate insulation thickness.

2.3.15 Pump Suction Strainers

Provide a cast iron strainer body, rated for not less than 25 psig at 100 degrees F, with flanges conforming to ASME B16.1, Class 125. Strainer construction is such that there is a machined surface joint between body and basket that is normal to the centerline of the basket.

Ensure minimum ratio of open area of each basket to pipe area is 3 to 1. Provide a basket with AISI 300 series corrosion-resistant steel wire mesh with perforated backing.

Ensure mesh is capable of retaining all particles larger than 1,000 micrometer, with a pressure drop across the strainer body of not more than 0.5 psi when the basket is two-thirds dirty at maximum system flow rate. Provide reducing fittings from strainer-flange size to pipe size.

Provide a differential-pressure gage fitted with a two-way brass cock across the strainer.

Provide manual air vent cocks in cap of each strainer.

2.3.16 Line Strainers, Water Service

Provide Y-type strainers with removable basket. Ensure strainers in sizes 2-inch ips and smaller have screwed ends; in sizes 2-1/2-inch ips and larger, strainers have flanged ends. Ensure body working-pressure rating exceeds maximum service pressure of installed system by at least 50 percent. Ensure body has cast-in arrows to indicate direction of flow. Ensure all strainer bodies fitted with screwed screen retainers have straight threads and gasketed with nonferrous metal. For strainer bodies 2-1/2-inches and larger, fitted with bolted-on screen retainers, provide offset blowdown holes. Fit all strainers larger than 2-1/2-inches with manufacturer's standard ball-type blowdown valve. Ensure body material is cast bronze conforming to ASTM B62. Where system material is nonferrous, use nonferrous metal for the metal strainer body material.

Ensure minimum free-hole area of strainer element is equal to not less

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

than 3.4 times the internal area of connecting piping. Strainer screens perforation size is not to exceed 0.045-inch. Ensure strainer screens have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material is AISI Type 304 corrosion-resistant steel.

2.3.17 NOT USED

2.4 VALVES

Submit equipment and performance data for valves consisting of corrosion resistance and life expectancy. Submit design analysis and calculations consisting of rates of flow, head losses, inlet and outlet design, and pressure calculations. Also include in data, pipe dimensions, as well as temperature ratings, vibration and thrust limitations, minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

Polypropylene valves will comply with the performance requirements of ASTM F2389. Valves shall conform to ASME B16.34.

2.4.1 Ball and Butterfly Valves

Ensure ball valves conform to MSS SP-72 for flanged valves and MSS SP-110 for screwed-end valves for Figure 1A 1 piece body, 1B vertically split body, 1C top entry 1D three piece body and are rated for service at not less than 175 psig at 200 degrees F. For valve bodies in sizes 2 inches and smaller, use screwed-end connection-type constructed of Class A copper alloy. For valve bodies in sizes 2-1/2 inches and larger, use flanged-end connection type, constructed of Class D material. Balls and stems of valves 2 inches and smaller are manufacturer's standard with hard chrome plating finish. Balls and stems of valves 2-1/2 inches and larger are manufacturer's standard Class C corrosion-resistant steel alloy with hard chrome plating. Balls of valves 6 inches and larger may be Class D with 900 Brinell hard chrome plating. Ensure valves are suitable for flow from either direction and seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. Ensure all valves have adjustable packing glands. Seats and seals are fabricated from tetrafluoroethylene.

Ensure butterfly valves conform to MSS SP-67 and are the wafer type for mounting between specified flanges. Ensure valves are rated for 150-psig shutoff and nonshock working pressure. Select bodies of cast ferrous metal conforming to ASTM A126, Class B, and to ASME B16.1 for body wall thickness. Seats and seals are fabricated from resilient elastomer designed for field removal and replacement.

2.4.2 Drain, Vent, and Gage Cocks

Provide T-head drain, vent, and gage cocks, ground key type, with washer and screw, constructed of polished ASTM B62 bronze, and rated 125-psi wsp. Ensure end connections are rated for specified service pressure.

Ensure pump vent cocks, and where spray control is required, are UL umbrella-hood type, constructed of manufacturer's standard polished brass. Ensure cocks are 1/2-inch ips male, end threaded, and rated at not less than 125 psi at 225 degrees F.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.4.3 Gate Valves (GAV)

Ensure gate valves 2 inches and smaller conform to MSS SP-80. For valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated use union-ring bonnet, screwed-end type. Make packing of non-asbestos type materials. Use rising stem type valves.

Ensure gate valves 2-1/2 inches and larger, are Type I, (solid wedge disc, tapered seats, steam rated); Class 125 (125-psig steam-working pressure at 353 degrees F saturation); and 200-psig, wog (nonshock), conforming to MSS SP-70 and to requirements specified herein. Select flanged valves, with bronze trim and outside screw and yoke (OS&Y) construction. Make packing of non-asbestos type materials.

2.4.4 Globe and Angle Valves (GLV-ANV)

Ensure globe and angle valves 2 inches and smaller, are 125-pound, 125-psi conforming to MSS SP-80 and to requirements specified herein. For valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated, use union-ring bonnet, screwed-end type. Ensure disc is free to swivel on the stem in all valve sizes. Composition seating-surface disc construction may be substituted for all metal-disc construction. Make packing of non-asbestos type materials. Ensure disk and packing are suitable for pipe service installed.

Ensure globe and angle valves, 2-1/2 inches and larger, are cast iron with bronze trim. Ensure valve bodies are cast iron conforming to ASTM A126, Class A, as specified for Class 1 valves under MSS SP-80. Select flanged valves in conformance with ASME B16.1. Valve construction is outside screw and yoke (OS&Y) type. Make packing of non-asbestos type materials.

2.4.5 Standard Check Valves (SCV)

Ensure standard check valves in sizes 2 inches and smaller are 125-psi swing check valves except as otherwise specified. Provide lift checks where indicated. Ensure swing-check pins are nonferrous and suitably hard for the service. Select composition type discs. Ensure the swing-check angle of closure is manufacturer's standard unless a specific angle is needed.

Use cast iron, bronze trim, swing type check valves in sizes 2-1/2 inches and larger. Ensure valve bodies are cast iron, conforming to ASTM A126, Class A and valve ends are flanged in conformance with ASME B16.1. Swing-check pin is AISI Type or approved equal corrosion-resistant steel. Angle of closure is manufacturer's standard unless a specific angle is needed. Ensure valves have bolted and gasketed covers.

Provide check valves with external spring-loaded , positive-closure devices and valve ends are mechanical joint .

2.4.6 Nonslam Check Valves (NSV)

Provide check valves at pump discharges in sizes 2 inches and larger with nonslam or silent-check operation conforming to MSS SP-125. Select a valve disc or plate that closes before line flow can reverse to eliminate slam and water-hammer due to check-valve closure. Ensure valve is Class 125 rated for 200-psi maximum, nonshock pressure at 150 degrees F in sizes to 12 inches. Use valves that are wafer type to fit between flanges conforming to ASME B16.1. Valve body may be cast iron, or equivalent

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

strength ductile iron. Select disks using manufacturer's standard bronze, aluminum bronze, or corrosion-resistant steel. Ensure pins, springs, and miscellaneous trim are manufacturer's standard corrosion-resistant steel. Disk and shaft seals are Buna-N elastomer tetrafluoroethylene.

2.5 MISCELLANEOUS MATERIALS

Submit equipment and performance data for miscellaneous materials consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

2.5.1 Bituminous Coating

Ensure the bituminous coating is a solvent cutback, heavy-bodied material to produce not less than a 12-mil dry-film thickness in one coat, and is recommended by the manufacturer to be compatible with factory-applied coating and rubber joints.

For previously coal-tar coated and uncoated ferrous surfaces underground, use bituminous coating solvent cutback coal-tar type, conforming to MIL-C-18480.

2.5.2 Bolting

Ensure flange and general purpose bolting is hex-head and conforms to ASTM A307, Grade B (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts conform to ASTM A563. Square-head bolts and nuts are not acceptable. Ensure threads are coarse-thread series.

2.5.3 Elastomer Caulk

Use two-component polysulfide- or polyurethane-base elastomer caulking material, conforming to ASTM C920.

2.5.4 Escutcheons

Manufacture escutcheons from nonferrous metals and chrome-plated except when AISI 300 series corrosion-resistant steel is provided. Ensure metals and finish conforms to ASME A112.19.2/CSA B45.1.

Use one-piece escutcheons where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. Ensure all escutcheons have provisions consisting of internal spring-tension devices for maintaining a fixed position against a surface.

2.5.5 Flange Gaskets

Provide compressed non-asbestos sheets, conforming to ASTM F104, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 750 degrees F.

2.5.6 Grout

Provide shrink-resistant grout as a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to ASTM C404 and ASTM C476.

Ensure shrink-resistant grout is a combination of pre-measured and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

packaged epoxy polyamide or amine resins and selected aggregate mortar grouting compound conforming to the following requirements:

Tensile strength		1,900 psi, minimum
Compressive strength	ASTM C109/C109M	14,000 psi, minimum
Shrinkage, linear		0.00012 inch per inch, maximum
Water absorption	ASTM C67/C67M	0.1 percent, maximum
Bond strength to		1,000 psi, minimum steel in shear minimum

2.5.7 Pipe Thread Compounds

Use polytetrafluoroethylene tape not less than 2 to 3 mils thick in potable and process water and in chemical systems for pipe sizes to and including 1-inch ips. Use polytetrafluoroethylene dispersions and other suitable compounds for all other applications upon approval by the Contracting Officer; however, do not use lead-containing compounds in potable water systems.

2.6 SUPPORTING ELEMENTS

Submit equipment and performance data for the supporting elements consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

Provide all necessary piping systems and equipment supporting elements, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. Ensure supporting elements are suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Ensure supporting elements conform to requirements of ASME B31.3, and MSS SP-58, except as noted.

Ensure attachments welded to pipe are made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Ensure supporting elements exposed to weather are hot-dip galvanized or stainless steel. Select materials of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Electroplate supporting elements in contact with copper tubing with copper.

Type designations specified herein are based on MSS SP-58. Ensure masonry anchor group-, type-, and style-combination designations are in accordance with CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925, CID A-A-55614, and CID A-A-55615. Provide support elements, except for supplementary steel, that are cataloged, load rated, commercially manufactured products.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.6.1 Building Structure Attachments

2.6.1.1 Anchor Devices, Concrete and Masonry

Ensure anchor devices conform to CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925, CID A-A-55614, and CID A-A-55615

For cast-in, floor mounted, equipment anchor devices, provide adjustable positions.

Provide built-in masonry anchor devices.

Do not use powder-actuated anchoring devices to support any mechanical systems components.

2.6.1.2 Beam Clamps

Ensure beam clamps are center-loading MSS SP-58 Type 20 .

When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, MSS SP-58 Type 20 may be used for piping sizes 2 inches and less and for piping sizes 2 through 10 inches provided two counterbalancing clamps are used per point of pipe support. Where more than one rod is used per point of pipe support, determine rod diameter in accordance with referenced standards.

2.6.1.3 Type 19 and 23 C-Clamps

Torque Type 19 and 23 C-clamps in accordance with MSS SP-58 and have both locknuts and retaining devices furnished by the manufacturer. Field fabricated C-clamp bodies or retaining devices are not acceptable.

2.6.1.4 Inserts, Concrete

Use concrete MSS SP-58 Type 18 inserts. When applied to piping in sizes 2 inches ips and larger and where otherwise required by imposed loads, insert and wire a 1-foot length of 1/2-inch reinforcing rod through wing slots. Submit proprietary-type continuous inserts for approval.

2.6.2 Horizontal Pipe Attachments

2.6.2.1 Single Pipes

Support piping in sizes to and including 2-inch ips by MSS SP-58 Type 6 solid malleable iron pipe rings, except that, use split-band-type rings in sizes up to 1-inch ips.

Support piping in sizes through 8-inch ips inclusive by MSS SP-58 Type 1 attachments.

Use MSS SP-58 Type 1 and Type 6 assemblies on vapor-sealed insulated piping and have an inside diameter larger than pipe being supported to provide adequate clearance during pipe movement.

Where thermal movement of a point in a piping system 4 inches and larger would cause a hanger rod to deflect more than 4 degrees from the vertical or where a horizontal point movement exceeds 1/2 inch, use MSS SP-58 Type 41 pipe rolls.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Support piping in sizes larger than 8-inch ips with MSS SP-58 Type 41 pipe rolls.

Use MSS SP-58 Type 40 shields on all insulated piping. Ensure area of the supporting surface is such that compression deformation of insulated surfaces does not occur. Roll away longitudinal and transverse shield edges from the insulation.

Provide insulated piping without vapor barrier on roll supports with MSS SP-58 Type 39 saddles.

Provide spring supports as indicated.

2.6.2.2 Parallel Pipes

Use trapeze hangers fabricated from structural steel shapes, with U-bolts, in congested areas and where multiple pipe runs occur. Ensure structural steel shapes conform to supplementary steel requirements.

2.6.3 Vertical Pipe Attachments

Ensure vertical pipe attachments are MSS SP-58 Type 8.

Include complete fabrication and attachment details of any spring supports in shop drawings.

2.6.4 Hanger Rods and Fixtures

Use only circular cross section rod hangers to connect building structure attachments to pipe support devices. Use pipe, straps, or bars of equivalent strength for hangers only where approved by the Contracting Officer.

Provide turnbuckles, swing eyes, and clevises as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.6.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, design and fabricate such supplementary steel in accordance with AISC 325.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Submit certificates for pipes, valves and specialties showing conformance with test requirements as contained in the reference standards contained in this section. Provide certificates verifying Surface Resistance, Shear and Tensile Strengths, Temperature Ratings, Bending Tests, Flattening Tests and Transverse Guided Weld Bend Tests.

Provide test reports for Hydrostatic Tests, Air Tests, Valve-Operating Tests, Drainage Tests, Pneumatic Tests, Non-Destructive Electric Tests and System Operation Tests, in compliance with referenced standards contained within this section.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Fabricate and install piping systems in accordance with ASME B31.3, MSS SP-58, and AWS WHB-2.9.

Submit Installation Drawings for pipes, valves and specialties. Drawings include the manufacturer's design and construction calculations, forces required to obtain rated axial, lateral, or angular movements, installation criteria, anchor and guide requirements for equipment, and equipment room layout and design. Ensure drawings specifically advise on procedures to be followed and provisions required to protect expansion joints during specified hydrostatic testing operations.

Ensure connections between steel piping and copper piping are electrically isolated from each other. Dielectric pipe unions shall be installed to prevent galvanic corrosion. The dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. The metal parts of the union shall be separated so that the electrical current is below one percent of the galvanic current which would exist upon metal-to-metal contact. Gaskets, flanges, and unions shall be installed in accordance with manufacturer's recommendations.

Make final connections to equipment with unions installed every 100 feet of straight run. Install unions in the line downstream of screwed- and welded-end valves.

Ream all pipe ends before joint connections are made.

Make screwed joints with specified joint compound with not more than three threads showing after joint is made up.

Apply joint compounds to the male thread only and exercise care to prevent compound from reaching the unthreaded interior of the pipe.

Install screwed unions, welded unions, or bolted flanges wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Securely support piping systems with due allowance for thrust forces, thermal expansion and contraction. Do not subject the system to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

Ensure field welded joints conform to the requirements of the AWS WHB-2.9, ASME B31.3, and ASME BPVC SEC IX.

Make piping systems butt weld joints with backing rings. Use compatible backing ring materials with materials being joined. Ensure joint configuration conforms to ASME B16.25.

For polypropylene pipe, make fusion-weld joints in accordance with the pipe and fitting manufacturer's specifications and product standards. Use fusion-weld tooling, welding machines, and electrofusion devices specified by the pipe and fittings manufacturer. Prior to joining, prepare the pipe and fittings in accordance with ASTM F2389 and the manufacturer's specifications. Ensure joint preparation, setting and alignment, fusion process, cooling times and working pressure are in accordance with the pipe and fitting manufacturer's specifications.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Accomplish preheat and postheat treatment of welds in accordance with ASME BPVC SEC IX and ASME B31.3.

3.2 VALVES

Install valves in piping mains and all branches and at equipment where indicated and as specified.

Install valves to permit isolation of branch piping and each equipment item from the balance of the system.

Install riser and downcomer drains above piping shutoff valves in piping 2-1/2 inches and larger. Tap and fit shutoff valve body with a 1/2-inch plugged globe valve.

Install valves unavoidably located in furred or other normally inaccessible places with access panels adequately sized for the location and located so that concealed items may be serviced, maintained, or replaced.

3.3 SUPPORTING ELEMENTS INSTALLATION

Install supporting elements in accordance with the referenced codes and standards.

Support piping from building structure. Do not support piping from roof deck or from other pipe.

Run piping parallel with the lines of the building. Space and install piping and components so that a threaded pipe fitting may be removed between adjacent pipes and so that there is no less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Arrange hangers on different adjacent service lines running parallel with each other in line with each other and parallel to the lines of the building.

Install piping support elements at intervals specified hereinafter, at locations not more than 3 feet from the ends of each runout, and not over 1 foot from each change in direction of piping.

Base load rating for all pipe-hanger supports on insulated weight of lines filled with water and forces imposed. Deflection per span is not exceed slope gradient of pipe. Ensure supports are in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe. For concentrated loads such as valves, reduce the allowable span proportionately:

<u>PIPE SIZE</u> <u>INCHES</u>	<u>ROD SIZE</u> <u>INCHES</u>	<u>STEEL PIPE</u> <u>FEET</u>	<u>COPPER PIPE</u> <u>FEET</u>
1 and smaller	3/8	8	6
1-1/4 to 1-1/2	3/8	10	8
2	3/8	10	8
2-1/2 to 3-1/2	1/2	12	12

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

PIPE SIZE INCHES	ROD SIZE INCHES	STEEL PIPE FEET	COPPER PIPE FEET
4 to 5	5/8	16	14
6	3/4	16	16
8 to 12	7/8	20	20
14 to 18	1	20	20
20 and over	1-1/4	20	20

Install vibration isolation supports where needed. Refer to Section 23 05 48.19 SEISMIC BRACING FOR HVAC where A/C equipment and piping is installed.

Support vertical risers independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Ensure risers have guides for lateral stability. For risers subject to expansion, install only one rigid support at a point approximately one-third down from the top. Place clamps under fittings unless otherwise specified. Support carbon-steel pipe at each floor and at not more than 15-foot intervals for pipe 2 inches and smaller and at not more than 20-foot intervals for pipe 2-1/2 inches and larger.

3.4 PENETRATIONS

Install effective sound stopping and adequate operating clearance to prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces include space above ceilings where no special acoustic treatment of ceiling is provided. Finish penetrations to be compatible with surface being penetrated.

Accomplish sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings by packing to high density with properly supported fibrous-glass insulation or, where ambient or surface temperatures do not exceed 120 degrees F, by foaming-in-place with self-extinguishing, 2-pound density polyurethane foam to a depth not less than 6 inches. Finish foam with a rasp. Ensure vapor barrier is not less than 1/8-inch thick vinyl coating applied to visible and accessible surfaces. Where high temperatures and fire stopping are a consideration, use only mineral wool with openings covered by 16-gage sheet metal.

3.5 SLEEVES

Install sleeves where piping passes through roofs, masonry, concrete walls and floors.

Continuously weld sleeves passing through steel decks to the deck.

Ensure sleeves that extend through floors, roofs, load bearing walls, and fire barriers are continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. Form all other sleeves by molded linear polyethylene liners or similar materials that are removable. Ensure diameter of sleeves is large enough to accommodate pipe, insulation, and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

jacketing without touching the sleeve and provides a minimum 3/8-inch clearance. Install a sleeve size to accommodate mechanical and thermal motion of pipe precluding transmission of vibration to walls and the generation of noise.

Pack the space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration solid with a mineral fiber conforming to ASTM C553 Type V (flexible blanket), to 1,000 degrees F. Install this packing wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, fill the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration with an elastomer caulk to a depth of 1/2 inch. Ensure all caulked surfaces are oil- and grease-free.

Ensure through-penetration fire stop materials and methods are in accordance with ASTM E814 and UL 1479.

Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

Ensure sleeve height above roof surface is a minimum of 12 and a maximum of 18-inches.

3.6 ESCUTCHEONS

Install escutcheons at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, install escutcheons on both sides of the partition. Where suspended ceilings are installed, install plates at the underside only of such ceilings. For insulated pipes, select plates large enough to fit around the insulation. Use chrome-plated escutcheons in all occupied spaces and of size sufficient to effectively conceal openings in building construction. Firmly attach escutcheons with setscrews.

3.7 NOT USED

3.8 UNDERGROUND PIPING INSTALLATION

Prior to being lowered into a trench, clean all piping, visually inspected for apparent defects, and tapped with a hammer to audibly detect hidden defects.

Further inspect suspect cast-ferrous piping by painting with kerosene on external surfaces to reveal cracks.

Distinctly mark defective materials found using a road-traffic quality yellow paint; promptly remove defective material from the site.

After conduit has been inspected, and not less than 48 hours prior to being lowered into a trench, coat all external surfaces of cast ferrous conduit with a compatible bituminous coating for protection against brackish ground water. Apply a single coat, in accordance with the manufacturer's instructions, to result in a dry-film thickness of not less than 12 mils.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Ensure excavations are dry and clear of extraneous materials when pipe is being laid.

Use wheel cutters for cutting of piping or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting is not permitted.

Begin laying of pipe at the low point of a system. When in final acceptance position, ensure it is true to the grades and alignment indicated, with unbroken continuity of invert. Blocking and wedging is not permitted.

Point bell or grooved ends of piping upstream.

Make changes in direction with long sweep fittings.

Install necessary socket clamping, piers, bases, anchors, and thrust blocking. Protect rods, clamps, and bolting with a coating of bitumen.

Support underground piping below supported or suspended slabs from the slab with a minimum of two supports per length of pipe. Protect supports with a coating of bitumen.

On excavations that occur near and below building footings, install backfilling material consisting of 2,000-psi cured compressive-strength concrete poured or pressure-grouted up to the level of the footing.

Properly support vertical downspouts; soil, waste, and vent stacks; water risers; and similar work on approved piers at the base and provided with approved structural supports attached to building construction.

Provide cleanout, flushing, and observation risers.

3.9 HEAT TRACE CABLE INSTALLATION

Field apply heater tape and cut to fit as necessary, linearly along the length of pipe after piping has been pressure tested and approved by the Contracting Officer. Secure the heater to piping with cable ties. Label thermal insulation on the outside, "Electrical Heat Trace."

Install power connection, end seals, splice kits and tee kit components in accordance with IEEE 515 to provide a complete workable system. Terminate connection to the thermostat and ends of the heat tape in a junction box. Ensure cable and conduit connections are raintight.

3.10 DISINFECTION

Disinfect water piping, including all valves, fittings, and other devices, with a solution of chlorine and water. Ensure the solution contains not less than 50 parts per million (ppm) of available chlorine. Hold solution for a period of not less than 8 hours, after which the solution contains not less than 10 ppm of available chlorine or redisinfect the piping. After successful sterilization, thoroughly flush the piping before placing into service. Flushing is complete when the flush water contains less than 0.5 ppm of available chlorine. Water for disinfected will be furnished by the Government. Approve disposal of contaminated flush water in accordance with written instructions received from the Environmental authority having jurisdiction through the Contracting Officer and all local, State and Federal Regulations.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.11 HEAT TRACE CABLE TESTS

Test heat trace cable system in accordance with IEEE 515 after installation and before and after installation of the thermal insulation. Test heater cable using a 1000 vdc megger. Minimum insulation resistance is 20 to 1000 megohms regardless of cable length.

3.12 OPERATION AND MAINTENANCE

Provide Operation and Maintenance Manuals consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Submit test data that is clear and readily legible.

3.13 PAINTING OF NEW EQUIPMENT

Factory or shop apply new equipment painting, as specified herein, and provided under each individual section.

3.13.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied withstands 125 hours in a salt-spray fog test, except that equipment located outdoors withstand 500 hours in a salt-spray fog test. Conduct salt-spray fog test in accordance with ASTM B117, and for that test the acceptance criteria is as follows: immediately after completion of the test, the inspected paint shows no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shows no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

Ensure the film thickness of the factory painting system applied on the equipment is not less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, design the factory painting system for the temperature service.

3.13.2 Shop Painting Systems for Metal Surfaces

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, 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. Selected color of finish coat is aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F receives 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.
- b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

temperatures between 120 and 400 degrees F Receives two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

- c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F receives two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 05 48.19

SEISMIC BRACING FOR MECHANICAL SYSTEMS
02/25

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 CIVIL ENGINEERS (ASCE)

ASCE 7-22 (2022; Supp 1 2023; Supp 2 2023) Minimum
Design Loads and Associated Criteria for
Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPVC SEC IX (2017; Errata 2018) BPVC Section
IX-Welding, Brazing and Fusing
Qualifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C105/A21.5 (2018) Polyethylene Encasement for
Ductile-Iron Pipe Systems

AWWA C116/A21.16 (2015) Protective Fusion-Bonded Coatings
for the Interior and Exterior Surfaces of
Ductile-Iron and Gray Iron Fittings

AWWA C153/A21.53 (2019) Ductile-Iron Compact Fittings for
Water Service

AWWA C213 (2022) Fusion-Bonded Epoxy Coatings and
Linings for Steel Water Pipe and Fittings

ASTM INTERNATIONAL (ASTM)

ASTM A536 (2024) Standard Specification for Ductile
Iron Castings

ASTM D1785 (2021) Standard Specification for
Poly(Vinyl Chloride) (PVC), Plastic Pipe,
Schedules 40, 80, and 120

ASTM D2665 (2014) Standard Specification for
Poly(Vinyl Chloride) (PVC) Plastic Drain,
Waste, and Vent Pipe and Fittings

ASTM F891 (2024) Standard Specification for
Coextruded Poly (Vinyl Chloride) (PVC)
Plastic Pipe with a Cellular Core

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA P-414 (January 2004) Installing Seismic
Restraints for Duct and Pipe

NSF INTERNATIONAL (NSF)

NSF/ANSI/CAN 61 (2024) Drinking Water System Components -
Health Effects

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

SMACNA 1981 (2008) Seismic Restraint Manual Guidelines
for Mechanical Systems, 3rd Edition

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2023; with Change 3, 2025) Structural
Engineering

UFC 3-301-02 (2023; with Change 1, 2025) Design of Risk
Category V Structures, National Strategic
Military Assets

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION
(VISCMA)

VISCMA 412 (2014) Installing Seismic Restraints for
Mechanical Equipment

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Apply the requirements for seismic protection measures described in this section, Section 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS, and on the drawings to the mechanical equipment and mechanical systems both inside and outside of the building along with exterior utilities and systems listed below. Where there is a conflict between the specifications and the drawings, the specifications will take precedence.

1.2.2 Mechanical Equipment

Mechanical equipment restraints must be in accordance with the requirements for equipment restraints specified in section 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS. Mechanical equipment to be seismically protected must include the following items to the extent required on the drawings or in other sections of these specifications:

Equipment/Components with $I_p = 1.0$

Expansion Air Separator Tanks	Valves and Fittings for Piping
Water Chiller Units	

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

	Air Handling Units
Pumps with Motors	
	Unit Heaters
	Exhaust, Return and Misc. Fans
	Pumps
Air Terminal Units	
	Instrumentation and Control for HVAC

1.2.3 Mechanical Systems

Mechanical systems to be seismically protected must include the following items to the extent required on the drawings or in this or other sections of these specifications:

- a. All Piping and Ducts Inside the Building Except as Specifically Stated Below Under "Items Not Covered By This Section".
- b. Chilled Water Distribution Systems Outside of Buildings.
- c. Steam, Water, Oil, Gas and Fuel Piping Outside of Buildings.
- d. All Water Supply Systems Outside of Buildings.
- e. Storm and Sanitary Sewer Systems Outside of Buildings.
- f. All Process Piping Outside of Buildings.
- g. Heat Distribution Systems (Supply, Return, and Condensate Return) Outside of Buildings.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.2.4 Contractor Designed Supports and Attachments

The supports and attachments for the mechanical equipment designated in paragraph Mechanical Equipment must be developed by the Contractor complying with the requirements of 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS. Submit design calculations as required by 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS.

Design and provide seismic supports and attachments for mechanical systems listed in paragraph Mechanical Systems in accordance with ASCE 7-22 Chapter 13 and as modified by UFC 3-301-01 UFC 3-301-02. Refer to 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS paragraph GENERAL REQUIREMENTS for Structural Design Criteria.

Provide documentation of an independent design review for mission critical (MC) component or systems bracing design. Documentation must be signed by the independent reviewer who must also be a registered structural engineer.

1.2.5 Items Not Covered By This Section

1.2.5.1 Fire Protection Systems

Install seismic protection of piping for fire protection systems as specified in Sections 21 30 00 FIRE PUMPS, 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION, 21 13 16 DRY PIPE SPRINKLER SYSTEMS, FIRE PROTECTION, 21 13 18 PREACTION SPRINKLER SYSTEMS, FIRE PROTECTION, and 21 13 24.00 10 AQUEOUS FILM-FORMING FOAM (AFFF) FIRE PROTECTION SYSTEM.

1.2.5.2 Items Requiring No Seismic Restraints

Seismic restraints are not required where specifically identified as exempt based on Seismic Design Category (SDC), component Importance Factor (Ip), and other applicable factors indicated within ASCE 7-22, Chapter 13 section Mechanical and Electrical Components. Provide listing of mechanical equipment exempt from seismic restraint requirement within the Design Calculations submittal package submitted in accordance with specification 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS.

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 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

Flexible Couplings or Joints

Coupling And Bracing

SD-03 Product Data

Flexible Couplings Or Joints;

Equipment Restraint;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

PART 2 PRODUCTS

2.1 GENERAL DESIGN REQUIREMENTS

Submit detailed seismic restraint drawings for mechanical equipment, duct systems, piping systems and any other mechanical systems. Include calculations, catalog cuts, templates, and erection and installation details, as appropriate, for the items listed below. Indicate thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction. A registered professional engineer must stamp the calculations and verify the capability of structural members to which bracing is attached for carrying the load from the brace. Include drawing for Designated Seismic System Equipment indicating the equipment location in the facility, sufficient to be used for the installation. Design must be based on actual equipment and system layout. Design must include calculated dead loads, static seismic loads and capacity of materials utilized for the connection of the equipment or system to the structure. Analysis must detail anchoring methods.

2.2 EQUIPMENT RESTRAINT

Equipment must be rigidly or flexibly mounted as indicated on the drawings and in accordance with 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS depending on vibration isolation requirements.

Roof mounted equipment such as cooling towers and condensers, both vibration isolated and nonisolated, must have support members designed and anchored to building structural steel or concrete as required for seismic restraint and wind loads.

2.3 FLEXIBLE JOINTS

Flexible joints must have same pressure and temperature ratings as adjoining pipe. Braided hoses must not be used where there is torsional or axial movement unless manufacturer allows it.

2.3.1 Braided Hose Expansion Joint

Braided hose expansion joint(s) must be installed in the locations indicated on the drawings and as required to accommodate any thermal expansion, contraction or seismic movement of the piping system. Joints must consist of two parallel sections of corrugated metal hose, compatible braid, and 180 degree return bend with inlet and outlet connections. Field fabricated loops are not acceptable. Braided hose expansion joint(s) must be installed in the locations indicated on the drawings and as required to accommodate any thermal expansion, contraction or seismic movement of the piping system. Joints must consist of two parallel sections of corrugated metal hose, compatible braid, and 180 degree return bend with inlet and outlet connections. Field fabricated loops must not be acceptable. Braided hose in a 60 degree flexible V loop arrangement must be used for small diameter pipe connections to coils in variable-air-volume (VAV) terminal units and fan coil units installed in suspended ductwork whether braced or unbraced.

All braided hose expansion joints must be manufactured in accordance with the documented manufacturers weld procedure specifications. The procedure

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

qualification record must be used to document the execution of this procedure and must follow the general "guidelines" of ASME BPVC SEC IX. Each individual welder must conform to the in-house procedure qualification record and be qualified prior to each production lot. The testing of each individual welder must be documented in a welding procedure qualification record.

2.3.1.1 Corrugated Hose

Corrugated hose must be Type 304 stainless steel . Braid must be Type 304 stainless steel for any series 300 stainless steel hose . Fittings materials of construction and end fitting type must be consistent with pipe material and equipment/ pipe connection fittings. Copper fittings must not be attached to stainless steel hose.

2.3.1.2 Flexible Hose Expansion Loops

Flexible hose expansion loops must have a factory supplied, hanger / support lug located at the bottom of the 180 degree return. Flexible hose expansion loop(s) must be furnished with a plugged FPT to be used for a drain or air release vent. Flexible hose expansion loop(s) must be rated with an operating pressure which is the same as the adjoining pipe. The operating pressure must be based on burst pressure with a 4 to 1 safety factor.

2.3.2 Double Ball Flexible Expansion Joint

Install flexible expansion joints manufactured of ductile iron conforming to the material requirements of ASTM A536 and AWWA C153/A21.53 in the locations indicated on the drawings. Provide foundry certification of material upon request. Each flexible expansion joint must be pressure tested prior to shipment against its own restraint to a minimum of 350 psi (250 psi for flexible expansion joints 2 inch and 30 inches diameter and larger.) A minimum 2:1 safety factor, determined from the published pressure rating, must apply. Factory Mutual Approval for the 3 inch through 12 inch sizes is required. Each flexible expansion joint must consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20°, 2" - 12"; 15°, 14" - 36"; 12°, 42"-48" and 4-inches minimum expansion. Additional expansion sleeves must be available and easily added or removed at the factory or in the field. Both standardized mechanical joint and flange end connections must be available.

2.3.2.1 Internal Surfaces

Line all internal surfaces (wetted parts) with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213. Sealing gaskets must be constructed of EPDM. The coating must meet NSF/ANSI/CAN 61.

2.3.2.2 Exterior Surfaces

Coat exterior surfaces with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C116/A21.16. Include appropriately sized polyethylene sleeves, meeting AWWA C105/A21.5, for direct buried applications.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.3.3 Double Ball Flexible Expansion Joint Gravity Drain (Non-Pressurized)

Flexible expansion joints gravity drain must be installed in the locations indicated on the drawings and must be manufactured of pvc. All connections whether solvent weld or mechanical must be restrained to allow movement to be transferred to expansion joint. Each ball must allow up to 15 degrees deflection.

End connection outside diameters must be compatible with ASTM D1785, ASTM D2665 and ASTM F891 PVC pipe and are to be solvent welded.

2.4 SUPPORTS AND ATTACHMENTS

Sway bracing materials and associated fasteners and anchors must be as specified in 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS

PART 3 EXECUTION

3.1 COUPLING AND BRACING

- a. Submit detail drawings, as specified here and throughout this specification, along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals must be complete in detail; must indicate thickness, type, grade, class of metal, and dimensions; and must show construction details, reinforcement, anchorage, and installation with relation to the building construction.
- b. Provide coupling installation conforming to the details shown on the drawings. Provisions of this paragraph apply to all piping within a 5 foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers must be braced at the most frequent interval as determined by applying the requirements of this specification to each piping run on the common support.
- c. Size bracing components as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, must not be used where it would interfere with thermal expansion of piping.
- d. Adjust isolators and restraints after piping systems has been filled and equipment is at its operating weight, following the manufacturer's written instructions.
- e. Install cables at a 45-degree slope. Where interference is present, the slope may be minimum of 30 degrees or a maximum of 60 degrees per VISCMA 412.

3.2 BUILDING DRIFT

Provide joints capable of accommodating seismic displacements for vertical piping between floors of the building, where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. Provide horizontal piping across expansion joints to accommodate the resultant of the drifts of each building unit in each orthogonal direction. For threaded piping, provide swing joints made of the same piping material. For piping with manufactured ball joints the seismic drift must be 0.002 feet per foot of height above the base where the seismic separation occurs; this drift

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

value must be used in place of the expansion given in the manufacturer's selection table.

3.3 FLEXIBLE COUPLINGS OR JOINTS

3.3.1 Building Piping

Provide flexible couplings or joints in building piping at bottom of all pipe risers for pipe larger than 3-1/2 inches in diameter. Laterally brace flexible couplings or joints without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to satisfy these requirements.

3.3.2 NOT USED

3.4 PIPE SLEEVES

Size pipe sleeves in interior non-fire rated walls to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve. Pipe sleeves in fire rated walls must conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.5 SPREADERS

Provide spreaders between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart. Apply spreaders at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Apply spreaders to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in accordance with the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.6 SWAY BRACES FOR PIPING

Provide sway braces to prevent movement of the pipes under seismic loading. Provide braces in both the longitudinal and transverse directions, relative to the axis of the pipe. Provide sufficient braces for equipment to resist a horizontal force as specified in UFC 3-301-01 UFC 3-301-02 without exceeding safe working stress of bracing components. Provide bracing that does not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications. For seismic analysis of horizontal pipes, the equivalent static force should be considered to act concurrently with the full dead load of the pipe, including contents.

3.6.1 Transverse Sway Bracing

Provide transverse sway bracing for steel and copper pipe at intervals not to exceed those shown on the drawings. All runs (length of pipe between end joints) must have a minimum of transverse bracing at each end. Provide transverse sway bracing for pipes of materials other than steel and copper at intervals not to exceed the hanger spacing as specified in

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.6.2 Longitudinal Sway Bracing

Provide longitudinal sway bracing at 40 foot intervals unless otherwise indicated. All runs (length of pipe between end joints) must have one longitudinal brace minimum. Construct sway braces in accordance with the drawings. Do not use branch lines, walls, or floors as sway braces.

3.6.3 Vertical Runs

Run is defined as length of pipe between end joints. Do not brace vertical runs of piping at intervals greater than 10 feet. Braces for vertical runs must be above the center of gravity of the segment being braced. Flexible couplings should be provided at the bottoms of risers for pipes larger than 3.5 in. (89 mm) in diameter. Flexible couplings and expansion joints should be braced laterally and longitudinally unless such bracing would interfere with the action of the couplings or joints. When pipes enter buildings, flexible couplings should be provided to allow for relative movement between the soil and building. Construct all sway braces in accordance with the drawings. Attach sway braces to the structural system. Do not connect to branch lines, walls, or floors.

3.6.4 Clamps and Hangers

Apply clamps or hangers on uninsulated pipes directly to pipe. Insulated piping must have clamps or hangers applied over insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

Hanger rod stiffener angle or strut bracing must be securely attached by a series of attachment clamps manufactured from a one piece metal stamping and must include all require attachment hardware and locking nuts. Attachment clamps made from aluminum or cast iron must not be used in seismic applications. Do not weld vertical braces to hanger rods.

3.7 SWAY BRACES FOR DUCTS

3.7.1 Braced Ducts

Provide bracing details and spacing for rectangular and round ducts in accordance with SMACNA 1981. However, the design seismic loadings for these items must not be less than loadings obtained using the procedures in UFC 3-301-01/UFC 3-301-02. Bracing must not attach to duct joints. Use shortest screws possible when penetrating ductwork to minimize airflow noise inside duct.

3.7.2 Unbraced Ducts

Attach hangers for unbraced ducts to the duct within 2 inches of the top of the duct with a minimum of two #10 sheet metal screws in accordance with FEMA P-414. Use shortest screws possible when penetrating ductwork to minimize airflow noise inside duct. Install unbraced ducts with a 6 inch minimum clearance to vertical ceiling hanger wires.

3.8 EQUIPMENT

3.8.1 Equipment Support Requirements

Refer to 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS for

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

requirements.

3.8.2 Controls

Ensure that controls for critical equipment that must remain operational after an earthquake are certified per 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS paragraph SPECIAL TESTING FOR SEISMIC-RESISTING EQUIPMENT and are served by emergency power as required.

3.9 ANCHORS

Refer to 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS for requirements.

3.10 SPECIAL TESTING FOR SEISMIC-RESISTING EQUIPMENT

Refer to 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS for requirements.

3.11 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS AND EQUIPMENT

Refer to 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS for requirements.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC 05/25

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

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (2016, 7th ed) National Standards for
Total System Balance

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB PROCEDURAL STANDARDS (2015) Procedural Standards for TAB
(Testing, Adjusting and Balancing)
Environmental Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70E (2024) Standard for Electrical Safety in
the Workplace

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

SMACNA 016 (2012) HVAC Air Duct Leakage Test Manual -
2nd Edition

SMACNA 1780 (2023) HVAC Systems - Testing, Adjusting
and Balancing, 4th Edition

1.2 DEFINITIONS

In some instances, terminology differs between this Contract and the TAB certifying body or the TAB Standard primarily because this section intends to use the industry standards specified, along with additional requirements listed within this section, to produce optimal results.

- a. AABC: Associated Air Balance Council
- b. Certifying Body: An independent body responsible for issuing a formal recognition, such as a certificate, proving that the certification meets specific national or international requirements.
- c. COTR: Contracting Officer's Technical Representative

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- d. DALT: Duct Air Leakage Testing (of HVAC duct systems such as supply air (SA), return air (RA), exhaust air (EA), relief air (LA), and outdoor air (OA)).
- e. DALT Failure: This phrase means "a leakage rate measured during DALT Field Work and Acceptance Testing which exceeds the allowable leakage rate for the duct test pressure and leakage class indicated."
- f. Duct System: When applied to DALT, this phrase means "complete duct system, inclusive of all ductwork, plenums, mains, branches, fittings and duct-mounted components and appurtenances, such as manual balancing dampers, control dampers, access doors, fire dampers, and duct-mounted coils, up to, but excluding flexible ducts and air-handling equipment, such as air-handling units (AHUs), dedicated outdoor air system (DOAS) units, fan coil units (FCUs), water source heat pumps (WSHPs), and variable-air volume (VAV) terminal units."
- g. HVAC: Heating, ventilating, and air-conditioning
- h. Season 1, Season 2: Depending upon when the project HVAC systems are completed and ready for TAB, Season 1 is defined as Cooling Season or Heating Season, thereby defining Season 2 as the other season.
 - (1) Cooling Season: A 30-day timeframe centered on the expected date of maximum cooling load or expected warmest day of the year, making the timeframe 10-July through 9-August.
 - (2) Heating Season: A 30-day timeframe centered on the expected date of maximum heating load or expected coldest day of the year, making the timeframe 20-December through 19-January.
- i. TAB: Testing, Adjusting, and Balancing (of HVAC and domestic hot-water recirculation systems).
- j. TAB Failure: This phrase means "a measurement taken during TAB Field Acceptance Testing which does not fall within the specified Acceptance Tolerance for a specific parameter."
- k. TAB Firm: AABC Certified Member Agency, NEBB Certified Firm, TABB Certified Contractor
- l. TAB Standard: Standard utilized by TAB Team based on TAB Firm's certifying body:
 - (1) AABC - National Standards for Total System Balance (AABC MN-1)
 - (2) NEBB - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems (NEBB PROCEDURAL STANDARDS)
 - (3) TABB - HVAC Systems Testing, Adjusting & Balancing Manual (SMACNA 1780)
- m. TAB Team Supervisor: AABC Test and Balance Engineer (TBE), NEBB TAB Certified Professional (TAB CP), TABB TAB Certified Supervisor
- n. TAB Team: TAB Firm personnel
- o. TABB: Testing, Adjusting and Balancing Bureau

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.3 GENERAL REQUIREMENTS

The work includes DALT and TAB of new and existing HVAC and domestic hot-water (DHW) recirculation systems, which are located within, on, under, between, and adjacent to buildings.

Perform TAB in accordance with the requirements of the TAB Standard identified by the TAB Firm's certifying body, as supplemented and modified by this specification section. Perform DALT in compliance with the procedures specified in SMACNA 016, as supplemented and modified by this specification section.

1.3.1 Support Personnel

Ensure the TAB Team Supervisor or TAB Team Field Leader is present full-time on the Contract site for overall management and direct observation of the DALT and TAB Field Work. Certified TAB Team Field Technicians may work independently of direct observation by the TAB Team Supervisor or Field Leader.

Ensure the technical personnel, such as factory representatives and HVAC controls contractor technicians, to operate HVAC equipment are present to enable the TAB Team to accomplish the DALT and the TAB measurement work. Provide the personnel to install field designated test ports and test apparatus connections.

1.3.2 Coordination

Coordinate testing schedules with work in other Sections performed on the components or systems to be tested. Ensure support personnel are present at the times required by the TAB Team and cause no delay in the DALT and the TAB Field Work.

1.4 RELATED REQUIREMENTS

Requirements for climate conditions during building pressure testing are specified in Section 01 91 19 BUILDING ENCLOSURE COMMISSIONING.

Requirements for thermal insulation of ductwork, piping, fittings, and valves are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

Requirements for coordination with commissioning are specified in Section 23 08 00 COMMISSIONING OF MECHANICAL AND PLUMBING SYSTEMS.

Requirements for Detail Drawings, construction and sealing of HVAC air distribution systems are specified in Section 23 30 00 HVAC AIR DISTRIBUTION.

1.5 SUBMITTALS

Unless otherwise specified or directed by the Contracting Officer, provide submittals in electronic format.

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

PROCEDURES:

SD-01 Preconstruction Submittals

TAB Firm And Personnel Qualifications; G,

Design Review Report; G,

TAB Pre-Field Engineering Plan; G,

SD-06 Test Reports

Phase 1 Pre-Final DALT Report; G,

Phase 2 Pre-Final DALT Report; G,

Certified Final DALT Report; G,

Phase 1 Certified TAB Report of Proportional Balancing; G,

Phase 1 Certified TAB Report of Season 1; G,

Phase 2 Certified TAB Report of Proportional Balancing; G,

Phase 2 Certified TAB Report of Season 1; G,

SD-11 Closeout Submittals

Phase 1 Certified TAB Report of Season 2; G,

Phase 2 Certified TAB Report of Season 2; G,

Certified Final TAB Report; G,

1.6 TAB FIRM AND PERSONNEL QUALIFICATIONS

Engage the services of a qualified TAB Firm to perform DALT and TAB work for this project. Only approved firm and personnel are allowed to perform DALT and TAB work on this Contract. Any firm or individual that has been the subject of disciplinary action by their certifying body within the 5 years preceding Contract Award is not eligible to perform any duties related to DALT and TAB. Any firm or individual that has been the subject of disciplinary action by their certifying body within the 5 years preceding Notice to Proceed is not eligible to perform any duties related to DALT and TAB. Comply with the following:

- a. Certification: Maintain TAB Firm and personnel certifications for the entire duration of duties specified. Renew Certifications which expire prior to completion of the TAB work in a timely manner so there is no lapse in certification. Provide written notice to the Contracting Officer, with a copy of renewed certificates of the TAB Firm and personnel, prior to expiration of the previous certificate(s). If, for any reason, the TAB Firm or its employee loses subject certification during this Contract, immediately notify the Contracting Officer in writing and comply with the requirements for the replacement of TAB Firm and TAB Team Members. An approved successor must validate all work performed for this project by the TAB Firm or TAB Team Member who lost certification.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- b. Replacement of TAB Firm and TAB Team Members: Replacement or substitution of firm or individual members may occur if each complies with the applicable qualifications and is approved by the Contracting Officer prior to the performance of its duties on this Contract. Submit replacement TAB Firm and Personnel Qualifications in accordance with this section.

Submit the TAB Firm and Personnel Qualifications within 60 calendar days after the date of Contract Award. Submit the TAB Firm and Personnel Qualifications within 60 calendar days after the date of Notice to Proceed.

1.6.1 TAB Firm

Provide documentation that the TAB Firm is a first tier subcontractor to the prime Contractor and an independent company, not participating in any other work on this Contract or affiliated to any other company participating in work on this Contract, including, but not limited to, design, furnishing equipment, or construction. No work may be performed by a second tier subcontractor.

Provide a copy of current certificate, with expiration date, to certify that the TAB Firm is certified by AABC, NEBB, or TABB in categories and functions of the DALT and TAB field work specified. Designate the single certifying body to be utilized when the firm is certified by more than one.

1.6.2 TAB Personnel

For each TAB Team role below, provide at least one qualified, full-time employee of the TAB Firm for approval. Include the proposed role(s) of each employee with their qualification documentation. It is acceptable for a TAB Team member to perform duties of another TAB Team role if they meet the qualifications of both.

a. TAB Team Supervisor

Provide documentation, including full name and a copy of current certificate, that the TAB Team Supervisor is a AABC TBE, a NEBB TAB CP, or a TABB TAB Certified Supervisor.

b. TAB Team Field Leader

Provide documentation that the TAB Team Field Leader is a certified TAB Technician by AABC, NEBB, or TABB, and has satisfactorily performed full-time supervision of TAB work of others in the field for a minimum of 3 years immediately preceding Contract Award. Provide documentation that the TAB Team Field Leader is a certified TAB Technician by AABC, NEBB, or TABB, and has satisfactorily performed full-time supervision of TAB work of others in the field for a minimum of 3 years immediately preceding Notice to Proceed. Include full name, a copy of current certificate, and a list of projects, roles performed, and associated dates.

c. TAB Team Field Technician

Provide documentation that each TAB Team Field Technician is a certified TAB Technician by AABC, NEBB, or TABB, or has satisfactorily performed DALT and TAB work in the field for a minimum of 1 year

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

immediately preceding Contract Award. Provide documentation that each TAB Team Field Technician is a certified TAB Technician by AABC, NEBB, or TABB, or has satisfactorily performed DALT and TAB work in the field for a minimum of 1 year immediately preceding Notice to Proceed.

Include full name, a copy of current certificate when applicable, and a list of projects, roles performed, and associated dates.

1.7 TAB STANDARD

All recommendations and suggested practices contained in the TAB Standard are mandatory. Maintain a hard copy and an electronic PDF file copy of the standard on site.

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 and report forms must be developed by the TAB Team Supervisor and included in the TAB Pre-Field Engineering Plan. Where new procedures and requirements, applicable to the Contract requirements have been published or adopted by the certifying body responsible for the TAB Standard, the more stringent of the requirements and recommendations contained in these procedures and requirements are considered mandatory.

1.8 INSTRUMENTATION

It is the responsibility of the TAB Firm to use instrumentation that meets the requirements of the TAB Standard. Select appropriate instruments to achieve the applicable TAB tolerances. Instrumentation used for taking air wet-bulb temperature readings must provide accuracy of a minimum of plus or minus 5 percent at the measured face velocities. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations. Instrumentation must be in proper operating condition and must be applied in accordance with the instrumentation's manufacturer recommendations.

All instrumentation must bear a valid National Institute of Standards and Technology (NIST) traceable calibration certificate, dated within one year, during field work and Field Acceptance Testing.

1.9 DESIGN REVIEW

The TAB Team Supervisor must review the Contract Plans and Specifications to advise the Contracting Officer of any omissions and deficiencies that would prevent the effective and accurate TAB of the systems in compliance with the requirements of this section, including performing the field work for the reporting of existing facility conditions. Accomplish the following:

- a. Verify in the documents the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, flow measuring devices, balancing valves, and manual balancing dampers.
- b. Confirm the inclusion of the design values necessary to complete the DALT and TAB report forms required for the TAB Pre-Field Engineering Plan.
- c. Generate a list of submittals, from those in the Contract Submittal

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Register of Section 01 33 00 SUBMITTAL PROCEDURES, that relate to the successful accomplishment of all HVAC and DHW recirculation systems TAB.

- d. Prepare a report containing a detailed listing of the items identified during the review. Provide the omission and deficiency listing in a tabular format, with each item sequentially numbered and with a reference to the applicable design document. For each omission and deficiency, provide a complete explanation including supporting documentation detailing the design deficiency. If no deficiencies are evident, state so in the report. In addition, the design engineer must respond to the Design Review Report items and the responses, with dated signature, must accompany the report. Include the TAB Related Submittals List in the report.

Submit the Design Review Report to the Contracting Officer for approval within 30 calendar days after approval of the TAB Firm and Personnel Qualifications.

1.10 TAB PRE-FIELD ENGINEERING PLAN

The TAB Team Supervisor must utilize the TAB Standard, Contract Plans, Contract Specifications, approved contract revisions, and contract change orders to prepare a plan for the DALT and TAB field work, including procedures, report forms, diagrams, instrumentation and other supporting documents in compliance with the following:

- a. Project Summary: Provide a detailed narrative describing the DALT and TAB Field Work to be performed, including systems and equipment. Clearly distinguish between DALT information and TAB information. Include separate sections for each construction phase.
- b. Step-by-Step Procedures: Provide a list of the intended procedural steps for DALT and TAB Field Work from start to finish. Include the following:
 - (1) The intended procedural steps for TAB work for systems, subsystems, and system components. TAB Standard procedure excerpts may be provided to supplement this requirement.
 - (2) A description of how each type of data measurement will be obtained.
 - (3) A complete methodology for accomplishing each seasonal TAB Field Work requirement.
 - (4) A list of Contractor support personnel required for each step, and tasks they need to perform.
- c. Report Forms: Provide the report forms to be used in the DALT and TAB reports to document the DALT and TAB Field Work, with the preliminary information and design values filled in. Utilize contract document design HVAC and DHW systems values. For TAB report forms, use forms inclusive of all data on TAB Standard sample report forms, or generate where no TAB Standard form exists, for all data collection requirements. Ensure report forms contain data fields for each HVAC controls system flow measuring device's calibration, including design flow rate, actual flow rate, controls system reading and factor. For DALT report forms, use forms comparable to the "Air Duct Leakage Test

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Summary Report Forms" located in SMACNA 016, with an example of design and test data in the plan. Coordinate the key numbering used in the report forms with that used in the TAB Schematic Drawings.

- d. TAB Schematic Drawings: Provide the schematic drawings to be used in the required reports, which may include building floor plans, mechanical room plans, equipment schedules, duct system plans, and equipment elevations. Use the contract drawings and, if available, ductwork shop drawings to provide the following:
 - (1) Air moving equipment and pump schedules.
 - (2) Thermal energy transfer equipment schedules.
 - (3) Duct Construction and Leakage Testing Schedule.
 - (4) Air system plans showing the location and airflow quantities of all supply, return, exhaust, relief, outdoor, and transfer air terminal devices such as registers, grilles, diffusers, louvers, and rooftop hoods and their respective airflow quantities.
 - (5) A key numbering system on the drawings which identifies each piece of equipment and each air terminal device contained in the air terminal airflow report sheets. It is acceptable to utilize the contract drawing numbering system when provided for equipment.
 - (6) A unique number or mark for each water flow measurement fitting and balancing valve. It is acceptable to utilize the contract drawing numbering system when provided for valves and fittings.
 - (7) Intended TAB measurement locations, including where test ports need to be provided by the Contractor.

For Static Pressure Profile and Duct Traverse Equipment Diagrams, provide diagrams, representative of the actual equipment configuration, developed from TAB Standard forms, contract drawings or approved equipment submittals.

For DALT schematic drawings, provide a representative diagram matching the example DALT report form in this plan.

- e. Instrumentation: Provide a list of DALT and TAB instruments for this project. Include the instrument name and description, manufacturer, model number, scale range, published accuracy, most recent calibration date, and what the instrument will be used for on this project. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified. Provide a copy of the calibration certificate for each calibrated instrument to be used.
- f. Pre-DALT Field Work Checklist: Provide a thorough checklist of the work items and inspections that need to be accomplished before DALT Field Work can be performed. Include signature and date lines for the Contractor's quality control representative and mechanical contractor's representative acknowledging completion of the marked checklist items.
- g. Pre-TAB Field Work Checklist: Provide a thorough checklist of the work items and inspections that need to be accomplished before the

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

proportional balancing, heating season, and cooling season TAB Field Work can be performed. Include items such as completion of applicable HVAC controls systems installation, cleaning of hydronic system including but not limited to strainers, and replacement of HVAC system air filters. Provide separate sections of checklist items for proportional balancing, heating season thermal performance testing, and cooling season thermal performance testing TAB Field Work. Each section must include signature and date lines for the Contractor's quality control representative and mechanical contractor's representative acknowledging completion of the marked checklist items.

Submit the TAB Pre-Field Engineering Plan to the Contracting Officer for approval a minimum of 60 calendar days in advance of commencement of TAB field work.

1.11 PRE-DALT/TAB MEETING

Meet with the Contracting Officer's Technical Representative (COTR) and the design engineer of the HVAC systems to develop a mutual understanding relative to the details of the DALT and TAB work requirements. Requirements to be discussed include required submittals, work schedules, and field quality control. Ensure that the TAB Team Supervisor and a representative for the sheet metal contractor, mechanical contractor, electrical contractor, and HVAC controls system contractor are present at this meeting. Conduct the Pre-DALT/TAB Meeting a minimum of 30 calendar days in advance of the commencement of ductwork installation.

Provide written notice to the Contracting Officer of the proposed date of the Pre-DALT/TAB Meeting at a minimum of 14 calendar days prior to the proposed date. The notice must include the proposed date and time; required, and optional if any, attendees' names and job titles; a copy of the current submittal register; and a copy of the current project schedule containing the sequencing and durations of the DALT and TAB activities and submittals in this section.

1.12 NOT USED

1.13 REPORTS

Format: All submitted documentation must be typed, neat, and organized. Include a dated title page, a certification page, a table of contents identifying the location of each report section, sequentially numbered pages throughout, and all sections bookmarked. Tables, lists, and diagrams must be titled. Handwritten report forms or report data are not acceptable.

Submit the completed report forms approved in the TAB Pre-Field Engineering Plan, and any other data sheets and supporting documentation necessary, to document the required design data; field measurements data; system configuration and settings during testing; design and installation deficiencies; and, required data evaluations. Reports must be completed by the TAB Team, and reviewed and certified by the TAB Team Supervisor.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.13.1 NOT USED

1.13.2 TAB Reports

Report the data for the Certified TAB Report of Proportional Balancing, Certified TAB Report of Season 1, and Certified TAB Report of Season 2 in compliance with the following requirements:

a. Project Summary: Provide a project narrative, including systems and equipment tested, describing the outcome of the testing and balancing and include a list of items documenting system variations deviating from the design tolerances, any abnormalities discovered, and any outstanding items with proposed corrective action. When applicable, provide notations describing how actual field procedures differed from those approved in the TAB Pre-Field Engineering Plan. If no procedures differed, state so in the report.

b. Certification: Include the TAB Team Supervisor's physical or electronic stamp, issued by the certifying body, and dated signature.

c. Data from TAB Field Work: Prepare the TAB field data using the report forms approved in the TAB Pre-Field Engineering Plan and any other data sheets necessary to document the required final system balance and demonstrate accuracy and repeatability during TAB Field Acceptance Testing. For each unique calibration factor utilized, report the traverse airflow, the flow measuring instrument reading (e.g., flow hood airflow), the resulting correction factor, and the location of the traverse taken. Include notation on each form with the date the form's data was collected and with any Supporting Document reference number. Provide a detailed explanation wherever a final measurement did not achieve the required value or fall within the required range of values. Include the following:

(1) System Configuration: Clearly identify system configurations and conditions affecting data for all reported data. Include system operational parameters such as device positioning, system diversity, modes of operation, and setpoints necessary to set up and duplicate the system configuration during the TAB Field Acceptance Testing. Include final hydronic differential pressure setpoint, hydronic system fill pressure, glycol percentage, pump and fan motor frequency in maximum, fan motor frequency in minimum, fan brake horsepower, calibration coefficients and factors, control damper positions, and primary air static pressure setpoint.

(2) Static Pressure Profiles: Provide static pressure profiles in accordance with this section. Illustrate pressures in an Equipment Diagram representative of the actual installation. Include design static pressure and differential pressure values for comparison where provided.

(3) Duct Traverses: Provide duct traverse measurement data in accordance with this section. Include individual velocities from the duct traverses taken. Illustrate, in an Equipment Diagram, the actual entering and leaving duct traverse airflows for each piece of air-handling equipment exceeding 2,000 CFM.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- (4) Air and Water Systems' Open Paths: Identify air and hydronic system open paths in the report form.
 - (5) Motor Data: Provide motor current (amperage) and voltage for each phase of motors, including those powered by VFDs. Include current setting for thermal overload protection for motors, including starter or VFD brand, model, enclosure type, installed overload devices, rating(s) or rating range, and setpoints, and revised device ratings and setpoints when applicable.
 - (6) Seasonal Thermal Performance Data: Include capacity field data and design and calculated capacity, along with ambient outdoor temperature data, on seasonal thermal performance report forms. Include notation to identify system configuration settings that deviate from the design sequences of operation and setpoints when necessary to obtain the design capacity.
- d. Flow Measuring Device Calibration: Provide calibration data at each scheduled design volumetric flow rate.
 - e. Instruments: Provide an updated list of the instruments used to measure the TAB data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Include a copy of the instrument calibration certificate when updated from the copy in the approved TAB Pre-Field Engineering Plan.
 - f. Performance Curves: Provide copies of the factory pump curves and fan curves for pumps and fans included on the job, and manufacturer equipment data curves or tables correlating pressure drop and water flow rate. Include marks or notation indicating the reported final balance values on each curve.
 - g. Calibration Charts: Provide a factory calibration chart, table, graph, or diagram, as applicable, for each applicable balancing valve and flow measuring device such as a venturi flow meter and an orifice flow meter.
 - h. TAB Schematic Drawings: Provide updated drawings and diagrams with the final installed locations of all terminals and devices, any numbering changes, and actual test locations including duct traverse and static pressure measurements. Indicate the air terminal device and water coil of the open paths for those identified.
 - i. Mechanical Equipment Schedules: Include a copy of the mechanical equipment schedules.
 - j. Supporting Documents: Provide copies of any request for information (RFI) with the RFI response; summaries of implemented change order(s); meeting minutes with participants; electronic mail with addresses; and, other documentation substantiating any deviations of the reported design values from the initial contract design documents. Include this documentation in an appendix to the TAB report with sequential numbering of each separate document for reference in the data presentation forms.
 - k. Guarantee: Provide documentation substantiating the inclusion of the quality assurance program such as a certificate of conformance or performance guarantee issued by the TAB Firm's certifying body.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.14 SEQUENCING AND SCHEDULING

1.14.1 Phased Construction

This project includes multiple phases. DALT and TAB work for each project phase must be scheduled separately and must correspond to each completion milestone in the master schedule. The DALT and TAB work, including all associated submittals, must be completed and approved with each phase, excluding Season 2, prior to turnover. At completion of the Season 2 TAB Field Acceptance Testing for the final phase in the building, compile all approved TAB reports and submit as one document..

1.14.2 Submittal and Work Schedule

This schedule is structured as though the HVAC and DHW systems construction, and thereby the DALT and TAB work, submittals, and field acceptance testing, is going to be completed in a single phase for the contract, including the seasonal work. All DALT and TAB field work, submittals, and acceptance testing must be planned and completed separately for each phase. Include the items listed in this schedule in the Project Schedule required by Section 01 32 01.00 10 PROJECT SCHEDULE. Ensure sufficient time is scheduled to complete each item, including Government review period for submittals. The order of items listed below does not imply a specified sequence:

- a. Submission of TAB Firm and Personnel Qualifications
- b. Submission of Design Review Report
- c. Submission of TAB Pre-Field Engineering Plan
- d. Pre-DALT/TAB Meeting
- e. Existing Facility Conditions Field Work
- f. Submission of Existing Facility Conditions Report
- g. DALT Field Work
- h. Submission of Pre-Final DALT Reports
- i. DALT Field Acceptance Testing
- j. Submission of Certified Final DALT Report
- k. Proportional Balancing TAB Field Work
- l. Submission of Certified TAB Report of Proportional Balancing
- m. Proportional Balancing TAB Field Acceptance Testing

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- n. Season 1 TAB Field Work
- o. Submission of Certified TAB Report of Season 1
- p. Season 1 TAB Field Acceptance Testing
- q. Season 2 TAB Field Work
- r. Submission of Certified TAB Report of Season 2
- s. Season 2 TAB Field Acceptance Testing

1.15 WARRANTY

Furnish workmanship and performance warranty for the DALT and TAB system work performed for a period of 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 outside of the tolerances noted within the TAB System Tolerance section, 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 are 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 DALT PROCEDURES

3.1.1 Systems Requiring DALT

All duct systems, regardless of duct pressure classification, are subject to DALT including supply, return, exhaust, relief, and outdoor air. From each duct system indicated as subject to DALT, the Contracting Officer will randomly select sections of each completed duct system for testing such that the duct selections will not exceed 25 percent of the total measured linear footage of each duct system. Include notation within the associated Advance Notice indicating the specific unit(s) when electing the following for any single unit or quantity of similar units:

- a. It is acceptable for an entire duct system associated with a single unit (e.g., 100 percent of AHU-1 supply air ductwork) to be leak tested instead of disassembling that system in order to DALT only the 25 percent duct selection specified. Testing an entire duct system for a unit does not reduce the DALT requirements for any other duct system or selection.
- b. It is acceptable for the duct systems (e.g., FCU supply air and return

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

air) for 25 percent of the total quantity of similar terminal units and light-duty air-handling equipment (e.g., WSHPs less than 5 tons cooling capacity, VAVs, and FCUs) to be leak tested instead of disassembling 25 percent of each duct system for each of these units.

3.1.2 Prerequisites for DALT Field Work

Complete the following prior to starting DALT Field Work:

- a. Submission and approval of the SD-01 Preconstruction Submittals.
- b. Installation and sealing in conformance with the contract documents of those duct systems indicated completed and ready for testing.
- c. Confirmation ductwork to be air leakage tested is accessible and not concealed or insulated.
- d. Work items and inspections indicated in the Pre-DALT Field Work Checklist.
- e. Furnish the TAB Team a copy of the ductwork layout Detail Drawings indicating the completed duct systems available for DALT.

3.1.3 Advance Notice for Pre-Final DALT Field Work

Provide the Contracting Officer with written notification including the proposed date for DALT and a copy of the ductwork layout Detail Drawings with indication and dimensions of the duct systems, or portion thereof, completed and ready for DALT. Include with the notice the signed and dated Pre-DALT Field Work Checklist, with all work items certified by the Contractor and mechanical contractor as completed.

Provide the notice after completion of the installation of duct systems indicated as ready for testing.

3.1.4 Ductwork Selections

From each duct system indicated within the Advance Notice of Pre-Final DALT Field Work, the Contracting Officer will select sections of each completed duct system for testing in accordance with this section. Maintain a hard copy of the drawings indicating ductwork selections on site.

Sealing of the ductwork selections is prohibited, with exception of temporary end caps and connection for test apparatus, from the time the Contractor is notified of the selections until DALT measurements are recorded.

3.1.5 DALT Field Work

Conduct DALT Field work on the ductwork selections in compliance with the procedures specified in SMACNA 016, as supplemented and modified by this section. Use a duct test pressure equivalent to each ductwork selection's pressure classification. Calculate the ductwork selection allowable leakage using the more stringent, lower numerical value, of the duct system leakage class for the duct pressure classification indicated on the drawings or the maximum permitted leakage class defined as follows:

- a. Round/Oval Leakage Class = 3 and Rectangular Leakage Class = 4 at duct

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

pressure classification of 4 in. WG and above.

- b. Round/Oval Leakage Class = 4 and Rectangular Leakage Class = 8 at duct pressure classification of 2 in. WG and 3 in. WG.
- c. Round/Oval Leakage Class = 8 and Rectangular Leakage Class = 16 at duct pressure classification of 1 in. WG.

Complete DALT Field Work on the ductwork selections within 48 hours from receipt of selections, including disconnection, capping, measuring, and testing of ductwork. If any of the duct sections tested is a DALT failure, terminate testing for that system and report the duct selection as failed and the duct system as DALT terminated in the Pre-Final DALT Report.

3.1.6 Pre-Final DALT Report

Upon completion of the DALT Field Work, prepare a Pre-Final DALT Report. Prepare separate Pre-Final DALT Reports when DALT is not completed in a single event for each phase and differentiate these with a sequential numerical suffix such as Pre-Final DALT Report 1.

Submit a Pre-Final DALT Report to the Contracting Officer for approval within two working days of completion of the DALT Field Work for each of the following:

Phase 1 Pre-Final DALT Report

Phase 2 Pre-Final DALT Report

3.1.7 Quality Assurance

3.1.7.1 DALT Field Acceptance Testing

In the presence of the Contracting Officer and TAB Team Field Leader, conduct field acceptance testing of a maximum of 50 percent of the duct sections in the approved Pre-Final DALT Report as selected by the Contracting Officer. If any of the duct sections tested is a DALT failure, terminate data checking for that section; the associated Pre-Final DALT Report data for the given duct selection will be disapproved.

Provide the Contracting Officer with written notification of the proposed date for DALT Field Acceptance Testing within 14 calendar days of approval of the Pre-Final DALT Report and a minimum of 7 calendar days in advance of proposed field acceptance testing date.

3.1.7.2 Retesting and Additional Testing

For any duct section indicated as a DALT failure, make the necessary repairs. Repairs must be applied to similar conditions in all untested duct sections. For each DALT failure, and after repairs are completed, conduct DALT on the untested duct selection(s) of the terminated duct system, on the failed section, and one additional duct section as selected by the Contracting Officer. Prepare and resubmit the Pre-Final DALT Report with the original, retesting, and additional selection test results for approval. Reschedule field acceptance testing of the approved revised

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

report with the Contracting Officer.

3.1.8 Certified Final DALT Report

Prepare the Certified Final DALT Report using data furnished by the TAB Team in the Pre-Final DALT Report(s) for each phase.

Submit the Certified Final DALT Report to the Contracting Officer for approval within 14 calendar days of successful completion of all DALT Field Acceptance Testing for the building.

3.2 TAB PROCEDURES

3.2.1 Systems Requiring TAB

All DHW recirculation, air and hydronic systems are subject to TAB.

3.2.2 TAB Tolerances

3.2.2.1 System Tolerances

System tolerances apply to the design flow rates as specified or indicated in the contract documents. HVAC systems' tolerance is plus or minus 5 percent, except as indicated below:

a. Air Systems:

- (1) OA 50 CFM or less: plus 5 CFM to minus zero CFM
- (2) EA 50 CFM or less: plus zero CFM to minus 5 CFM
- (3) SA and RA of 100 percent recirculating single-zone air-handling equipment: plus or minus 10 percent
- (4) SA and RA 50 CFM or less: plus or minus 3 CFM

b. Hydronic Systems:

- (1) Heating Hot-Water (HHW) at coils: plus or minus 10 percent

c. Other Systems:

- (1) DHW Recirculation: plus or minus 10 percent

3.2.2.2 Acceptance Tolerances

Field Acceptance Testing measurements must remain within the associated System Tolerance of the design flow rate.

3.2.3 Advance Notice for TAB Field Work

Provide the Contracting Officer with written notification including the proposed dates for TAB Field Work and a list of the systems ready for TAB on the proposed start date. Include with the notice the signed and dated Pre-TAB Field Work Checklist, with the applicable work items certified by the Contractor and mechanical contractor as having been completed and working as designed.

Furnish the Advance Notice for Proportional Balancing TAB Field Work, for

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Season 1 TAB Field Work, and for Season 2 TAB Field Work TAB Field Work prior to start of the TAB Field Work.

3.2.4 Proportional Balancing TAB Field Work

Conduct TAB Field Work in conformance with the TAB Standard, as supplemented and modified by this section. Test, adjust, and balance the HVAC and DHW recirculation systems until measured flow rates (air and water flow) are within the specified System Tolerances. Do not exceed maximum rated revolutions per minute (RPM) and rated full load amperage for equipment during any mode of operation, including with loaded filters and wet cooling coils. Variable speed drives must be capable of controlling to maximum and minimum flows with a drive operational range not less than 25 Hz. Operation exceeding 60 Hz is permitted only for direct-drive plenum fans rated for operation at higher frequencies. Follow the procedures specified in NFPA 70E during electrical measurements on exposed energized conductors or circuits. Additionally, this work includes the following:

- a. Adjustment of flow control and balancing devices such as balancing valves, balancing dampers, and sheaves.
- b. Adjustment of variable frequency drives and speed controllers.
- c. Calibration of each controls system flow measuring device at each scheduled design volumetric flow rate.
- d. Changing out fan sheaves if required to obtain flow rates specified or indicated.

3.2.4.1 Prerequisites for TAB Field Work

Complete the following prior to starting Field Work:

- a. DALT Field Work and obtain approval of the Certified Final DALT Report.
- b. Installation of pressure and temperature test ports adjacent to inlet and outlet of every pump, heat exchanger, chiller, boiler, and coil, and as required by the TAB Team Supervisor.
- c. Work items and inspections indicated in the Pre-TAB Field Work Checklist, including providing new air filters and cleaning screens of hydronic system strainers.
- d. Enclosure of the building envelope according to the contract documents with the Air Barrier Pressure Test completed and the Air Leakage Test Reports and Diagnostic Test Reports approved. Hydronic system TAB field work may commence prior to air barrier test completion.
- e. Manufacturer's equipment start-up forms for each piece of equipment to be tested.
- f. HVAC controls system installation and start-up for each piece of equipment to be tested.

3.2.4.2 TAB Air Distribution Systems

Balance systems to minimize throttling losses with at least one open path, with fully open balancing dampers from the fan discharge to an outlet and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

from fan suction to an inlet, for fans greater than 1 hp.

a. Static Pressure Profile Work

Measure and record static pressure profiles under maximum airflow conditions for air systems of 2,000 CFM and greater.

Measure static pressure data for supply, return, relief, exhaust, and outdoor air ducts for the systems. The static pressure measurement data must include, in addition to TAB Standard requirements, the following:

- (1) Inlet and discharge static pressures for fans.
- (2) Static pressure drop across coils and heat reclaim devices installed in unit cabinetry or the system ductwork.
- (3) Static pressure drop across automatic control dampers.
- (4) Static pressure drop across air filters, acoustic silencers, moisture eliminators, airflow straighteners, airflow measuring stations, and other pressure drop producing specialty items installed in unit cabinetry or in the system ductwork. Examples of these specialty items are smoke detectors, white sound generators, RF shielding, wave guides, security bars, blast valves, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows with or without turning vanes, transitions, offsets, plenums, manual dampers, and branch take-offs.

- (5) Report static pressure drop across louvers.
- (6) Report static pressure readings in the duct at the point where the ducts connect to air-handling equipment.

b. Duct Traverse Work

Perform duct traverses, in addition to TAB Standard requirements, for main and each branch main supply, return, exhaust, relief and outdoor air ducts for each piece of air-handling equipment exceeding 1,000 CFM. Include those ducts which lack 7 1/2 duct diameters upstream and 3 duct diameters downstream of straight duct unobstructed by duct fittings, offsets, and elbows. Perform additional duct traverses as shown on the contract drawings. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a satisfactory pitot traverse plane as defined by AMCA 203.

c. Building Pressurization Work

Perform measurements upon completion of air system balancing and during climate conditions suitable for a pressure test in accordance with Section 01 91 19 BUILDING ENCLOSURE COMMISSIONING. Record building differential pressure for all sides of the building on each floor where openings allow measurements by instrumentation. Report all system setup parameters affecting building pressure measurement (e.g., exhaust, relief and outdoor airflow, damper positions, and fan speeds) and indicate wind speed during time of building pressure

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

measurements. Measure in maximum and minimum building systems configuration.

Measurements must occur during building system setup with building exterior doors and windows closed and as follows:

- (1) Occupied Mode; air-handling equipment with all zones satisfied such as VAVs at minimum design airflow.

Measure differential pressure for the following locations: .

3.2.4.3 TAB Hydronic and Domestic Hot Water Distribution Systems

Balance systems to minimize throttling losses with at least one path, with fully open balancing valves, from the pump discharge to a terminal device and back to the pump suction, for pumps greater than 1 hp. Measure and record flow rates at all balancing valves and flow measuring devices.

3.2.4.4 Marking of Settings and Test Ports

Upon completing each item of work for TAB Field Work specified and prior to TAB Field Acceptance Testing, the TAB Team is to permanently mark the settings of HVAC adjustment devices including valves, gauges, and dampers so that adjustment can be restored if disturbed at any time. Secure balancing damper handles and set valve memory stops. Label variable frequency drives with final frequency (Hz) and control setpoint. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the Certified TAB Report. Permanently and legibly mark and identify the duct test ports. If the ducts have external insulation, make these markings on the exterior side of the 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.

3.2.5 Seasonal Thermal Performance TAB Field Work

Perform operational thermal performance testing of the HVAC systems as soon as all prerequisites are completed, but prior to facility turnover, regardless of the season. In addition, perform thermal performance testing during Season 1 and Season 2 when the outdoor air temperature (OAT) is within the seasonal temperature ranges below for equipment with performance that is OAT dependent. It is acceptable to conduct Season 1 testing prior to the applicable season dates if all prerequisites are complete including OAT within range.

- a. Cooling Season: XX to XX degrees F dry-bulb temperature.
- b. Heating Season: XX to XX degrees F dry-bulb temperature.

3.2.5.1 Prerequisites for Season 1 Thermal Performance Field Work

Complete the following prior to starting Field Work:

- a. Proportional Balancing TAB Field Work.
- b. Work items and inspections indicated in the Pre-TAB Field Work Checklist for the applicable season, including confirming clean

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

filters and strainers.

- c. Advance Notice for Season 1 TAB Field Work.
- d.

3.2.5.2 Thermal Performance Testing

Conduct thermal performance (capacity) tests to verify thermal energy transfer components, devices, and equipment meet the indicated design capacity. This work includes:

- a. Verifying, using the same procedures and instruments for proportional balancing TAB field work, flows (air and water) remain within the System Tolerances. If the measurements exceed the specified System Tolerances, report these as deficiencies in accordance with this section.
- b. Measuring water temperatures through immersion into fluid stream.
- c. For ducted units, measuring airflows via duct traverse.
- d. Measuring the range, from minimum to maximum, of the outdoor ambient dry-bulb temperature and corresponding dew-point temperature within which the TAB seasonal data was recorded. Record these temperature ranges on each day of seasonal data measurements.

Report all design data, actual field measurements, and capacity calculations for the components, devices, and equipment below.

3.2.5.3 Units with Coils

Report heating and cooling performance tests for heating and cooling coils such as heating hot-water, chilled-water, direct-expansion, and steam coils:

- a. For units with capacities greater than 7.5 tons (90,000 BTU/H) cooling, such as factory manufactured units, central built-up units and rooftop units, determine the apparent air-side coil capacity by calculations utilizing direct measurement of airflow, and measurements of entering and leaving wet-bulb and dry-bulb temperatures for cooling capacity and dry-bulb temperatures only for heating capacity. Calculate water-side coil capacity utilizing direct measurements of water flow rate, and entering and leaving water temperatures. Measure and record coil water pressure drop.

Measure and report dry-bulb temperature and relative humidity within the supply air duct downstream of each cooling coil. Report the corresponding dewpoint temperature.

- b. For units with capacities of 7.5 tons (90,000 BTU/H) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, determine the apparent air-side coil capacity by calculations using direct measurement of airflow, single point measurement centered within the airstream of entering and leaving wet-bulb and dry-bulb temperatures for cooling capacity and dry-bulb temperatures only for heating capacity.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2.5.4 Units with Heat Recovery Devices

Report heating and cooling energy recovery performance tests for energy recovery devices such as wheels, coils, and fixed plate exchangers.

Report total cooling capacity, heating capacity, and energy recovery effectiveness. For outdoor air and exhaust airstreams measure and report airflows and entering and leaving wet-bulb and dry-bulb temperatures across heat recovery device. For water-side calculations, utilize direct measurements of water flow rate and entering and leaving water temperatures. Measure and record water pressure drops.

3.2.5.5 Thermal Energy Transfer Equipment

Report heating and cooling performance tests for thermal energy transfer equipment (e.g., boilers, chillers, and cooling towers). Measure and report water flow rates, water-side pressure drops, and entering and leaving water temperatures. Report capacities.

3.2.6 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 or system design or installation prevent TAB work from being accomplished in accordance with this section, the TAB Team Supervisor must submit written notification within five working days from discovery of all such deficiencies for resolution. The TAB Firm must issue notice concurrently to the Contractor for corrective action and to the Contracting Officer for information. Provide a complete explanation, including supporting documentation, detailing the deficiencies and proposed corrective actions in the notification. Where deficiencies are encountered that adversely impact successful completion of:

- a. TAB Field Work: Resolve deficiencies prior to submission of the Certified TAB Report.
- b. TAB Field Acceptance Testing: The Contractor must, within five working days of the TAB Firm notice, submit written notification directly to the Contracting Officer, with a separate copy to the TAB Firm, of all such deficiencies, the intended or implemented corrective action, and the planned or actual date(s) for completion of each corrective action.

Responsibility for correction of design and installation deficiencies is the Contractor's. Responsibility for correction of installation deficiencies is the Contractor's.

3.2.7 Certified TAB Reports

Upon completing each item of work for TAB Field Work specified, prepare a TAB Report in accordance with this section using data furnished by the TAB Team. In addition, the design engineer must review the Certified TAB Report and the comments, with dated signature, must accompany the report. If there are no comments generated during the Certified TAB Report review process, state so in the report. Prepare separate Certified TAB Reports, identified as indicated, for each construction phase for the project.

Submit a Certified TAB Report of Proportional Balancing to the Contracting Officer for approval within 14 calendar days of completion of the

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Proportional Balancing TAB Field Work for each of the following:

Phase 1 Certified TAB Report of Proportional Balancing

Phase 2 Certified TAB Report of Proportional Balancing

Submit a Certified TAB Report of Season 1 to the Contracting Officer for approval within 14 calendar days of completion of the Season 1 TAB Field Work for each of the following:

Phase 1 Certified TAB Report of Season 1

Phase 2 Certified TAB Report of Season 1

Provide a copy of the approved Certified TAB Report data in an electronic spreadsheet file, along with all supporting graphs, charts, and curves, within 21 calendar days of receipt of TAB Report approval.

3.2.8 Quality Assurance

3.2.8.1 TAB Field Acceptance Testing

In the presence of the Contracting Officer and TAB Team Field Leader, conduct field acceptance testing of points and areas in the approved Certified TAB Report as selected by the Contracting Officer. The selections include data types such as water and air volumetric flow rates, velocity, pressure, rotational speed (RPM), temperature, and electrical current recorded in the TAB Report. Measurement and test procedures are the same as required for TAB Field Work. If any of the measurements is a TAB failure, the Contracting Officer may terminate data verification. The sample group will be disapproved and require retesting and additional testing. Conduct TAB Field Acceptance Testing for the Certified TAB Report of Season 1 and for the Certified TAB Report of Season 2 within the applicable Cooling Season or Heating Season.

Provide the Contracting Officer with written notification of the proposed date for Proportional Balancing TAB Field Acceptance Testing within 14 calendar days of approval of the Certified TAB Report of Proportional Balancing and a minimum of 7 calendar days in advance of proposed TAB Field Acceptance Testing date. Provide the Contracting Officer with separate written notification of the proposed date for Season 1 and for Season 2 TAB Field Acceptance Testing within 7 calendar days of approval of the associated Certified TAB Report and a minimum of 7 calendar days in advance of proposed TAB Field Acceptance Testing date.

3.2.8.2 Sample Strategy

Field acceptance testing includes verification of selections using the sample strategy indicated for each Category. For each of the following Categories, the Contracting Officer will select a sample group for testing:

Category 1: 100 percent of the air system equipment such as DOAS units, AHUs (rooftop and central stations), return fans, computer room air-conditioning (CRAC) units, and energy recovery units (ERUs) and 25 percent of the associated air terminal devices.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Category 2: 100 percent of the water system equipment such as chillers, boilers, cooling towers, pumps, DHW heaters, and Category 1 equipment's coils.

Category 3: 25 percent of the air terminal units (e.g., VAV terminal units, FCUs), and of the exhaust fans, supply fans, and relief fans and 100 percent of the selected equipment's air terminal devices.

Category 4: 25 percent of the hydronic and DHW recirculation systems' flow measuring devices (e.g., manual balancing valves and flow meters) and Category 3 equipment's hydronic coils.

Quantity is rounded up to a whole number for a sample size and is a minimum of three units or devices when three or more exist.

3.2.8.3 Retesting and Additional Testing

For any data indicated as a TAB Failure and when the data verification is terminated, make the necessary corrections, conduct TAB Field Work, set and secure balancing devices, and mark settings. Prepare and resubmit the applicable TAB Report with the corrected test results for approval. Reschedule TAB Field Acceptance Testing of the approved revised report with the Contracting Officer. For each TAB Failure, and after the revised report is approved, conduct field acceptance testing of the failed data point, one additional selection by the Contracting Officer from the same Category for each failure, and new selections by the Contracting Officer in the same Category using the Category's sample strategy. If there is insufficient quantity of data in the same Category, the Contracting Officer may select data from a different Category.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Season 2 Thermal Performance TAB Field Work

Perform operational thermal performance testing of the HVAC systems during Season 2 when the OAT is within the seasonal temperature range.

3.3.1.1 Prerequisites for Season 2 Thermal Performance Field Work

Complete the following prior to starting Field Work:

- a. Proportional Balancing TAB Field Work.
- b. Work items and inspections indicated in the Pre-TAB Field Work Checklist for the applicable season, including confirming clean filters and strainers.
- c. Advance Notice for Season 2 TAB Field Work.
- d.

3.3.1.2 Season 2 Thermal Performance Testing

Conduct thermal performance (capacity) tests to verify thermal energy transfer components, devices, and equipment meet the indicated design capacity within the parameters for Season 2. Prepare separate Certified TAB Reports, identified as indicated, for each construction phase and a final, consolidated Certified Final TAB Report inclusive of TAB Field Work

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

for all phases upon completion of all TAB Field Acceptance Testing
required for the project.

Submit a Certified TAB Report of Season 2 to the Contracting Officer for
approval within 14 calendar days of completion of Season 2 TAB Field Work
for each of the following:

Phase 1 Certified TAB Report of Season 2

Phase 2 Certified TAB Report of Season 2

3.4 PREREQUISITE FOR SYSTEMS ACCEPTANCE

Compliance with field acceptance testing requirements of this section is a
prerequisite for the final Contracting Officer acceptance of the HVAC
systems.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS 08/24

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

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M	(2025) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A580/A580M	(2023) Standard Specification for Stainless Steel Wire
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C195	(2007; R 2024) Standard Specification for Mineral Fiber Thermal Insulating Cement
ASTM C450	(2008) Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
ASTM C533	(2017; R 2023) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534/C534M	(2024) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C547	(2022a) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C552	(2022) Standard Specification for Cellular

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Glass Thermal Insulation

ASTM C553	(2024) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C591	(2022) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C610	(2017; R 2023) Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C612	(2014; R 2019) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C647	(2008; R 2013) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C755	(2019b) Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation
ASTM C795	(2008; R 2023) 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; R 2024) Standard Specification for Elastomeric Joint Sealants
ASTM C921	(2010; R 2015) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C1126	(2024) Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C1136	(2023) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C1290	(2016; R 2021) Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C1710	(2011) Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form
ASTM D882	(2012) Tensile Properties of Thin Plastic Sheeting

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASTM D2863	(2019) Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM E84	(2024) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2024a) Standard Test Methods for Gravimetric Determination of Water 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
ASTM E2336	(2020) Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2017; Version 1.2) 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 https://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
----------------------	--

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2024) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 90B	(2024) Standard for the Installation of Warm Air Heating and Air Conditioning Systems

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2022) Adhesive and Sealant Applications

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T403 OM (2022) Bursting Strength of Paper

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

MIL-PRF-19565 (1988; Rev C) Coating Compounds, Thermal
Insulation, Fire- and Water-Resistant,
Vapor-Barrier

UL SOLUTIONS (UL)

UL 94 (2023; Reprint Jan 2024) UL Standard for
Safety Tests for Flammability of Plastic
Materials for Parts in Devices and
Appliances

UL 723 (2023) UL Standard for Safety Test for
Surface Burning Characteristics of
Building Materials

UL 2818 (2022) 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. Provide insulation of heat distribution systems and chilled water systems outside of buildings as specified in Section 33 61 13 PRE-ENGINEERED UNDERGROUND HEAT DISTRIBUTION SYSTEM, Section 33 63 13.19 CONCRETE TRENCH HYDRONIC AND STEAM ENERGY DISTRIBUTION, Section 33 60 02 ABOVEGROUND HEAT DISTRIBUTION SYSTEM, and Section 33 61 13.13 PREFABRICATED UNDERGROUND HYDRONIC ENERGY DISTRIBUTION. Provide field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S"

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

classification. Submittals not having a "G" or "S" classification are 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:

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;

Pipe Insulation Systems and Associated Accessories

Duct Insulation Systems and Associated Accessories

Equipment Insulation Systems and Associated Accessories

Recycled content for insulation materials; S

SD-03 Product Data

Pipe Insulation Systems;

Duct Insulation Systems;

Equipment Insulation Systems;

SD-04 Samples

Thermal Insulation;

Display Samples;

SD-07 Certificates

Indoor air quality for adhesives; S

SD-08 Manufacturer's Instructions

Pipe Insulation Systems;

Duct Insulation Systems;

Equipment Insulation Systems;

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualification

Qualified installers must 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 and is an acceptable product per this specification. 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2 MATERIALS

Provide insulation that meets or exceeds 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 Mineral Fiber Insulation Cement

Provide cement in accordance with ASTM C195.

2.2.1.3 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. 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, as listed by the manufacturer, 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.

2.2.1.4 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers must have high impact strength, ultraviolet (UV) resistant rating or treatment and moderate chemical resistance. The minimum thickness for a Standard jacket is 0.020 inch and where high abuse resistance is required use Heavy Duty PVC jacket 0.030 inch. Standard PVC fittings will have an initial core thickness (before thermoforming) of 0.025 inch and heavy duty fittings will have an initial core thickness of 0.030 inch.

2.2.8.3 Vapor Barrier/Weatherproofing Jacket

Provide laminated self-adhesive vapor barrier/weatherproofing jacket, greater than 3 plies standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with less than 0.02 permeability when tested in accordance with ASTM E96/E96M, using the water transmission rate test method; heavy duty, white or natural; and UV resistant. Flexible Elastomeric exterior foam with factory applied, UV Jacket made with a cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent Water Vapor Transmission (WVT) rate.

2.2.8.4 Vapor Barrier/Vapor Retarder

Apply the following criteria to determine which system is required.

- a. On ducts, equip piping and equipment operating below 50 degrees F or located outside with a vapor barrier.
- b. Install ducts, pipes and equipment that are located inside and that always operate above 50 degrees F with a vapor retarder where required as stated in paragraph VAPOR RETARDER REQUIRED.

2.2.9 Vapor Retarder Required

ASTM C921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Use jackets on insulation exposed in finished areas that have white finish suitable for painting without sizing. Based on the application, insulation materials that require manufacturer or fabricator applied pipe insulation jackets are cellular glass, when all joints are sealed with a vapor barrier mastic, and mineral fiber. Ensure all non-metallic jackets have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible elastomerics require (in addition to vapor barrier skin) vapor retarder jacketing for high relative humidity

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

and below ambient temperature applications.

2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

ASJ is for use on hot/cold pipes, ducts, or equipment indoors or outdoors if covered by a suitable protective jacket. Provide product which meets all physical property and performance requirements of ASTM C1136, Type I, except a minimum burst strength of 85 psi. ASTM D2863 Limited Oxygen Index (LOI) is a minimum of 31.

In addition, do not use paper or other moisture-sensitive material for the outer exposed surface or the inner-most surface contacting the insulation. Ensure the outer exposed surface is white and has an emittance no less than 0.80.

2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

2.2.9.2.1 Vapor Barrier

The vapor barrier must be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plies standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Ensure permeability is less than 0.02 when tested in accordance with ASTM E96/E96M. Provide products meeting UL 723 or ASTM E84 flame and smoke requirements and that are UV resistant.

2.2.9.2.2 Vapor Retarder

Provide fire and water resistant vapor retarder coating appropriately selected for either outdoor or indoor service. Color must be white. Ensure the water vapor permeance of the compound is in accordance with ASTM C755. Provide nonflammable, fire resistant coating. Ensure coating meets MIL-PRF-19565 Type II (if selected for indoor service) and is Qualified Products Database listed. Determine all other application and service properties pursuant to ASTM C647.

2.2.9.3 Laminated Film Vapor Retarder

ASTM C1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork; where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Provide vapor retarder with a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible Elastomeric exterior foam with factory applied UV Jacket. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and an excellent WVT rate.

2.2.9.4 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

Provide PVDC film vapor retarder with a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested in accordance with ASTM D882, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.9.5 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for Laminated Film Vapor Retarder above.

2.2.9.6 Vapor Barrier/Weather Barrier

Ensure the vapor barrier is greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (permeability less than 0.02 when tested in accordance with ASTM E96/E96M). Provide vapor barrier meeting UL 723 or ASTM E84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with TAPPI T403 OM . Tensile strength 68 lb/inch width (PSTC-1000). Provide tape as specified for laminated film vapor barrier above.

2.2.10 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.

2.2.11 Wire

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

2.2.12 Insulation Bands

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

2.2.13 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 - SIASHRAE 90.1 - IP. Limit pipe insulation materials to those listed herein and meeting the following requirements:

2.3.1 Recycled Materials

Provide insulation materials containing the following minimum percentage of recycled material content by weight:

Rock Wool: 75 percent slag of weight
Fiberglass: 20 percent glass cullet
Rigid Foam: 9 percent recovered material
Phenolic Rigid Foam: 9 percent recovered material

Provide data identifying percentage of recycled content for insulation materials.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

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

2.3.2.1 Cellular Glass

ASTM C552, Type II, and Type III. Supply the insulation from the fabricator with (paragraph WHITE VAPOR RETARDER ALL SERVICE JACKET (ASJ)) ASJ vapor retarder and installed with all longitudinal overlaps sealed and all circumferential joints ASJ taped or supply the insulation unfaced from the fabricator and install with all longitudinal and circumferential joints sealed with vapor barrier mastic.

2.3.2.2 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.

2.3.2.3 Polyisocyanurate Insulation

ASTM C591, Type I. Polyisocyanurate insulation may only be used on systems operating at temperatures not to exceed 140 degrees F. 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.

2.3.3 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.

2.3.3.1 Mineral Fiber

ASTM C547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.3.2 Calcium Silicate

ASTM C533, Type I indoor only, or outdoors above 250 degrees F pipe temperature. Supply insulation with the manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.3.3 Cellular Glass

ASTM C552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.3.4 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

2.3.3.5 Phenolic Insulation

ASTM C1126 Type III to 250 degrees F service must comply with ASTM C795. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.3.6 Perlite Insulation

ASTM C610

2.3.3.7 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.

2.3.4 Aboveground Dual Temperature Pipeline

Select insulation for use over a dual temperature pipeline system (Outdoor, Indoor - Exposed or Concealed) in accordance with the most limiting/restrictive case. Find an allowable material from paragraph PIPE INSULATION MATERIALS and determine the required thickness from the most restrictive case. Use the thickness listed in paragraphs INSULATION THICKNESS for cold & hot pipe applications.

2.3.5 Below-ground Pipeline Insulation

For below-ground pipeline insulation, use cellular glass, ASTM C552, type II.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Factory Applied Insulation

Provide factory-applied ASTM C552, cellular glass thermal insulation according to manufacturer's recommendations for insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier, with identification of installed thermal resistance (R) value and out-of-package R value.

2.4.2 Field Applied Insulation

2.4.2.1 General

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

2.4.3 Rigid Insulation

Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB; 3.0 pcf. Provide insulation with factory applied ASJ jacket. Minimum thickness in accordance with ASHRAE 90.1 - IP

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.4.4 Blanket Insulation

Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket; 3/4 pcf. Minimum thickness in accordance with ASHRAE 90.1 - IP.

2.4.5 Kitchen Exhaust Ductwork Insulation

Ensure insulation thickness is a minimum of 2 inches, blocks or boards, either mineral fiber conforming to ASTM C612, Class 5, 20 pcf average. Provide enclosure materials and grease duct enclosure systems which meet testing requirements of ASTM E2336 for noncombustibility, fire resistance, durability, internal fire, and fire-engulfment with a through-penetration fire stop.

2.4.6 Acoustical Duct Lining

2.4.6.1 General

For ductwork indicated or specified in Section 23 30 00 HVAC AIR DISTRIBUTION to be acoustically lined, provide external insulation in accordance with this specification section and in addition to the acoustical duct lining if R-value would not be met as required in Table 3 and 4. The installation of internal acoustical duct insulation is prohibited.

2.4.6.2 Duct Liner

Flexible Elastomeric Acoustical and Conformable Duct Liner Materials: Flexible Elastomeric Thermal, Acoustical and Conformable Insulation Compliance with ASTM C534/C534M Grade 1, Type II; and NFPA 90A or NFPA 90B as applicable.

2.4.7 Duct Insulation Jackets

2.4.7.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface.

2.4.7.2 Metal Jackets

2.4.7.2.1 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.

2.4.7.2.2 Stainless Steel Jackets

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.4.7.3 Vapor Barrier/Weatherproofing Jacket

Provide vapor barrier/weatherproofing jacket that is laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) less than 0.02 permeability, (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).

2.4.8 Weatherproof Duct Insulation

Provide ASTM C552, cellular glass thermal insulation, and weatherproofing as specified in manufacturer's instruction. Multi-ply, Polymeric Blend Laminate Jacketing: Construction of laminate designed to provide UV resistance, high puncture, tear resistance and an excellent WVT rate.

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 specified in other paragraphs of this specification are completed. Remove material such as rust, scale, dirt and moisture from surfaces to receive insulation. Keep insulation 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. The protection of ducts at point of passage through firewalls must be in accordance with NFPA 90A and NFPA 90B. All other penetrations, such as piping, conduit, and wiring, through firewalls must be protected with a material or system of the same hourly rating that is listed by UL, FM, or a NRTL.

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 with 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

one hour after installation.

3.1.4.2 Adhesive Safety Precautions

Use natural cross-ventilation, local (mechanical) pickup, 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 Std's 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. Air chambers.
- b. Adjacent insulation.
- c. ASME stamps.
- d. Access plates of fan housings.

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 0.02 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 from 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.

3.2.1.2.6 Hot Water Pipes Supplying Lavatories or Other Similar Heated Service

Terminate the insulation on the backside of the finished wall. Protect the insulation termination with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). Extend the coating out onto the insulation 2 inches and seal the end of the insulation. Overlap glass tape seams 1 inch. Caulk the annular space between the pipe and wall penetration with approved fire stop material. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. Ensure the escutcheon plate overlaps the wall penetration at least 3/8 inches.

3.2.1.2.7 Domestic Cold Water Pipes Supplying Lavatories or Other Similar Cooling Service

Terminate the insulation on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). Protect the insulation with two coats of weather barrier mastic (breather emulsion type weatherproof mastic impermeable to water and permeable to air) with a minimum total thickness of 1/16 inch. Extend the mastic out onto the insulation 2 inches and seal the end of the insulation. Caulk the annular space between the outer surface of the pipe insulation and the wall penetration with an approved fire stop material having vapor retarder properties. Cover the pipe and wall penetration with a properly sized

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

(well fitting) escutcheon plate. Ensure the escutcheon plate overlaps the wall penetration by at least 3/8 inches.

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 welded PVC, 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 0.02 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 of ASHRAE 90.1 - IP. All refrigerant piping must be insulated in accordance with Section 23 81 29 VARIABLE REFRIGERANT FLOW HVAC SYSTEMS. Insulate these refrigerant lines according to the temperature of the pipe contents while the Variable Refrigerant Flow (VRF) system is fully operating following the temperature parameters as stated in Table 1 and Table 2 of this specification.

TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd
Chilled Water (Supply & Return, Dual Temperature Piping, 40 F nominal)					
	Cellular Glass	ASTM C552	II	2	Yes
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		Yes
	Polyisocyanurate	ASTM C591	I	2	Yes

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd
Heating Hot Water Supply & Return, Heated Oil (Max 250 F)					
	Mineral Fiber	ASTM C547	I	1	No
	Calcium Silicate	ASTM C533	I		No
	Cellular Glass	ASTM C552	II	2	No
	Faced Phenolic Foam	ASTM C1126	III		Yes
	Flexible Elastomeric Cellular	ASTM C534/C534M	I	2	No
	Polyisocyanurate Max temp	ASTM C591	I	2	Yes
Cold Domestic Water Piping, Makeup Water, and Condenser Water Piping					
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)					
	Mineral Fiber	ASTM C547	I	1	No
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
	Faced Phenolic Foam	ASTM C1126	III		Yes
Refrigerant Suction Piping (35 degrees F nominal)					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
	Cellular Glass	ASTM C552	II	1	Yes
Compressed Air Discharge, Steam and Condensate Return (201 to 250 Degrees F					
	Cellular Glass	ASTM C552	II		No
	Mineral Fiber	ASTM C547	I	1	No
	Calcium Silicate	ASTM C533	I		No
	Faced Phenolic Foam	ASTM C1126	III		Yes
	Perlite	ASTM C610			No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I	2	No
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel					

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd
	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
Medium Temperature Hot Water, Steam and Condensate (251 to 350 Degrees F)					
	Mineral Fiber	ASTM C547	I	1	No
	Calcium Silicate	ASTM C533	I		No
	Cellular Glass	ASTM C552	I or II		No
High Temperature Hot Water & Steam (351 to 700 Degrees F)					
	Mineral Fiber	ASTM C547	I	2	No
	Calcium Silicate	ASTM C533	I		No
	Cellular Glass	ASTM C552			No
Brine Systems Cryogenics (-30 to 0 Degrees F)					
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Brine Systems Cryogenics (0 to 34 Degrees F)					
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Note: VR/VB = Vapor Retarder/Vapor Barrier					

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE 2							
Piping Insulation Thickness (inch)							
Service							
	Material	Conductivity K-value (Btu-in/ hr-ft^2-deg F)	Tube And Pipe Size (inch)				
			<1	1-<1.5	1.5-<4	4-<8	> or = >8
Chilled Water (Supply & Return, Dual Temperature Piping, 40 Degrees F nominal)							
	Cellular Glass	0.30	1.5	1.5	1.5	1.5	2
	Flexible Elastomeric Cellular	0.235	1	1	1	N/A	N/A
	Polyisocyanurate	0.18	0.5	1	1	1	1.5
Heating Hot Water Supply & Return, Heated Oil (Max 250 F)							
	Mineral Fiber	0.27	2.5	2.5	2.5	3	3
	Calcium Silicate	0.37	4	4	4	4	4
	Cellular Glass		3.5	3.5	3.5	4	4
	Faced Phenolic Foam	0.24	2.5	2.5	2.5	3	3
	Polyisocyanurate Max temp 140F	0.23	1	1	1.5	1.5	1.5
Cold Domestic Water Piping, Makeup Water, and Condenser Water							
	Cellular Glass	0.30	1.5	1.5	1.5	1.5	1.5
	Flexible Elastomeric Cellular	0.235	1	1	1	N/A	N/A

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE 2							
Piping Insulation Thickness (inch)							
Service							
	Material	Conductivity K-value (Btu-in/ hr-ft ² -deg F)	Tube And Pipe Size (inch)				
			<1	1-<1.5	1.5-<4	4-<8	> or = >8
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)							
	Mineral Fiber	0.26	1.5	1.5	2	2	2
	Cellular Glass	0.34	2	2	2.5	2.5	2.5
	Flexible Elastomeric Cellular	0.30	1.5	1.5	2	N/A	N/A
Refrigerant Suction Piping (35 degrees F nominal)							
	Flexible Elastomeric Cellular	0.235	1	1	1	N/A	N/A
	Cellular Glass	0.29	1.5	1.5	1.5	1.5	1.5
Compressed Air Discharge, Steam and Condensate Return (201 to 250 Degrees F)							
	Mineral Fiber	0.27	2.5	2.5	2.5	3	3
	Calcium Silicate	0.37	2.5	3	4	4	4.5
	Cellular Glass	0.35	2	2.5	3	3	3
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel							
	Flexible Elastomeric Cellular		0.5	0.5	0.5	0.5	0.5
Condensate Drain Located Inside Building							

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE 2							
Piping Insulation Thickness (inch)							
Service							
	Material	Conductivity K-value (Btu-in/ hr-ft ² -deg F)	Tube And Pipe Size (inch)				
			<1	1-<1.5	1.5-<4	4-<8	> or = >8
	Cellular Glass	0.30	1.5	1.5	1.5	1.5	1.5
	Flexible Elastomeric Cellular	0.235	1	1	1	N/A	N/A
Medium Temperature Hot Water, Steam and Condensate (251 to 350 Degrees F)							
	Mineral Fiber	0.29	2.5	3.5	4	4.5	4.5
	Calcium Silicate	0.39	5	6.5	6.5	6.5	6.5
High Temperature Hot Water & Steam (351 to 700 Degrees F)							
	Mineral Fiber	0.32	4.5	5	5	5	5
	Calcium Silicate	0.41	4.5	5	6	6	6
Brine Systems Cryogenics (-30 to 0 Degrees F)							
	Cellular Glass	0.25	2.5	2.5	3	3	3.5
	Flexible Elastomeric Cellular	0.24	1	1	N/A	N/A	N/A
Brine Systems Cryogenics (0 to 34 Degrees F)							
	Cellular Glass	0.29	2	2	2	2.5	3

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE 2							
Piping Insulation Thickness (inch)							
Service							
	Material	Conductivity K-value (Btu-in/ hr-ft ² -deg F)	Tube And Pipe Size (inch)				
			<1	1-<1.5	1.5-<4	4-<8	> or = >8
	Flexible Elastomeric Cellular	0.26	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. Horizontal and vertical portions of interior roof drains.
- c. Refrigerant suction lines.
- d. Chilled water.
- e. Dual temperature water, i.e. HVAC hot/chilled water.
- f. Air conditioner condensate drains.
- g. Brine system cryogenics.
- h. Condenser water piping where pipe temperature may fall below ambient dew point.
- i. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.
- j. Domestic cold and chilled drinking water.

3.2.2.1 Insulation Material and Thickness

Determine insulation thickness for cold pipelines using Table 2.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 0.02 permeability, standard grade, silver, 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, PVC jacket or fittings (installed over a vapor retarder jacket), or greater than 3 ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.02 permeability, standard grade, Embossed Silver, White & Black, install the insulation and vapor retarder jacket as specified herein. Install the aluminum jacket, PVC jacket or fittings (installed over a vapor retarder jacket), or greater than 3 ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.02 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, PVC jacket or fittings (installed over a vapor retarder jacket), or greater than 3 ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.02 permeability, standard grade, embossed silver, white & black, for pipe insulation to the 6 ft level. Other areas that specifically require protection to the 6 ft level are .

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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. Factory precut insulation inserts or premolded insulation segments must be used under the fitting covers for elbows, tees and other miscellaneous configurations. Insulation inserts must be the same installed insulation thickness. One insert must be installed for each inch of pipe insulation. The installed and compressed insert must have the same thermal performance as the pipe insulation. Premolded insulation segments must be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. PVC fitting covers must be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. For above ambient pipe temperatures, secure PVC covers using tacks. As an option circumferential joints can be covered with PVC vapor retarder tape. For below ambient conditions seal system using PVC vapor retarder tape, and vapor retarder mastic with vapor dams. Longitudinal seams may be sealed with vapor retarder mastic, PVC vapor retarder tape or solvent weld adhesive to obtain a continuous vapor seal. For severe service conditions install PVC jackets over the existing ASJ jacket and seal using a solvent weld adhesive.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 insulation inserts or preformed insulation inserts around all fittings and accessories. Insulation inserts must be the same installed insulation thickness as the pipe insulation. One insert must be installed for each inch of pipe insulation thickness. The installed and compressed insert must have the same thermal performance as the pipe insulation. Preformed insulation inserts must be 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 0.02 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket, stainless steel or PVC jacket).

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

PVC jacketing requires no factory-applied jacket beneath it, however apply an all service jacket if factory applied jacketing is not furnished.

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/flashings 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. PVC fitting covers must be sealed based upon the pipe temperature in combination with ambient conditions and if the pipe insulation will be exposed to severe service conditions. For below ambient conditions, the pipe insulation and insulation fittings must be covered and sealed with a vapor barrier or weatherproofing jacket with a minimum 0.02 permeability as defined per ASTM C1136 before installing the PVC jacket and fitting cover. When in doubt as to the pipe temperature or service conditions, secure the PVC jacket using a weld adhesive using the manufacturer's recommended adhesive.

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 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 NOT USED

3.3 DUCT INSULATION SYSTEMS INSTALLATION

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

Except for oven hood exhaust duct insulation, install corner angles on

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Omit duct insulation on exposed supply and return ducts in air conditioned spaces where the difference between supply air temperature and room air temperature is less than 15 degrees F unless otherwise shown. 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
Warm 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- n. Ducts exposed to weather.
- o. Combustion air intake ducts.
- p. Exhaust ducts passing through concealed spaces, unconditioned spaces, or semi-heated spaces exhausting conditioned air.

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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. Insulation for both concealed or exposed round or oval ducts must be 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. Insulation for all exposed ducts must be provided with either a white, factory-applied Type I jacket or a field applied vapor retarder or vapor barrier jacket coating finish as specified, the total field applied dry film thickness must be approximately 1/16 inch.
- i. 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, unconditioned spaces, or semi-heated 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 insulation 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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. After the insulation is repaired, identify on the outside of the insulation with marker, sticker, or other means "TAB test ports."

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 0.02 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 0.02 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.

3.3.8 NOT USED

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 and chilled water pumps.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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
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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 flashing 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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
	Calcium Silicate/Perlite	4
	Cellular Glass	3
	Faced Phenolic Foam	1.5
	Flexible Elastomeric Cellular (<200 F)	1
200psig or 400 degrees F		

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE 6		
Insulation Thickness for Hot Equipment (inches)		
Equipment handling steam or media at indicated pressure or temperature limit		
	Material	Thickness (inches)
	Rigid Mineral Fiber	3
	Flexible Mineral Fiber	3
	Calcium Silicate/Perlite	4
	Cellular Glass	4
600 degrees F		
	Rigid Mineral Fiber	5
	Flexible Mineral Fiber	6
	Calcium Silicate/Perlite	6
	Cellular Glass	6
600 degrees F: Thickness necessary to limit the external temperature of the insulation to 120 F. Submit heat transfer calculations to substantiate insulation and thickness selection.		

3.4.3.2 NOT USED

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 08 00

COMMISSIONING OF MECHANICAL AND PLUMBING SYSTEMS

05/23, CHG 1: 08/24

PART 1 GENERAL

Building Commissioning is a systematic, quality-focused process for enhancing the delivery of a project that focuses on verifying and documenting that all of the commissioned systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the project requirements. The purpose is to reduce the cost and performance risks associated with delivering facilities projects, and to increase value to owners, occupants, and users. Comply with specification Section 01 91 00.15 BUILDING COMMISSIONING.

1.1 SEQUENCING AND SCHEDULING

Complete the following prior to starting Functional Performance Tests of mechanical systems:

- a. All equipment and systems completed, cleaned, flushed, disinfected, calibrated, tested, and operate in accordance with contract documents and construction plans and specifications
- b. Final DALT Report submitted and approved in accordance with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC
- c. Pre-final Testing, Adjusting, and Balancing Report submitted in accordance with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC
- d. Performance Verification Tests of the controls systems have been completed and the Performance Verification Test Report has been submitted and approved in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.
- e. The Certificate of Readiness submitted and approved in accordance with Section 01 91 00.15 BUILDING COMMISSIONING
- f. Air Leakage Test Reports and Diagnostic Test Reports submitted and approved in accordance with Section 01 91 19 BUILDING ENCLOSURE COMMISSIONING
- g. Tests, Flushing, and Disinfection in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE

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 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-03 Product Data

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Test Equipment;

SD-06 Test Reports

Pipe Flushing, Testing, And Water Treatment Reports;

Completed Pre-Functional Checklists;

SD-07 Certificates

Certificate Of Readiness;

1.3 ACCESSIBILITY REQUIREMENTS

Equipment, systems, and devices for commissioned systems must be accessible. Make necessary modifications if systems and devices are not accessible for inspections and testing.

Assist commissioning team in testing by removing equipment covers, opening access panels, and other required activities that assist with visual oversight. Furnish ladders, flashlights, meters, gauges, or other inspection equipment as necessary.

1.4 COORDINATION

Refer to Section 01 91 00.15 BUILDING COMMISSIONING for requirements pertaining to coordination during the commissioning process. Coordinate with the Lead Commissioning Specialist in accordance with Section 01 91 00.15 and in accordance with the Commissioning Plan to schedule inspections as required to support the commissioning process. Furnish additional information requested by the Lead Commissioning Specialist. Coordinate scheduling of Functional Performance Testing with the commissioning team. Provide plans, reports, notes, and other documentation to the Lead Commissioning Specialist as specified in the commissioning plan, as it is completed.

1.5 PIPE FLUSHING, TESTING, AND WATER TREATMENT REPORTS

Test requirements are specified in Division 23 piping Sections. Prepare a pipe system cleaning, flushing, and hydrostatic testing log. Provide cleaning, flushing, testing, and water treatment log and final reports.

Include the following in the pipe system cleaning, flushing, and hydrostatic testing log:

- a. Minimum flushing water velocity.
- b. Water treatment reports.
- c. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

1.6 CERTIFICATE OF READINESS

Submit Certificate of Readiness documentation in accordance with Section 01 91 00.15 BUILDING COMMISSIONING for all equipment and systems including start-up reports; completed Pre-Functional Checklists; Testing, Adjusting, and Balancing (TAB) Report; Issues Log; HVAC Controls Start-Up Reports;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Performance Verification Test Reports; and the building envelope Air Leakage Test Reports and Diagnostic Test Reports. Do not schedule Functional Performance Tests for the system until the Certificate of Readiness for that system receives approval by the Government. The CxC, Quality Control Manager, and the Mechanical, Electrical, Controls, and TAB subcontractor representatives must sign and date the Certificate of Readiness.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

Provide all testing equipment required to perform testing for the systems to be commissioned, except for equipment specific to and used by TAB as required by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Provide a sufficient quantity of two-way radios for each subcontractor. Submit list of Test Equipment and instrumentation to be used for testing including equipment/instrument identification number, equipment application or planned use, manufacturer, make, model, and serial number, and calibration history with certificates. Also list special equipment and proprietary tools specific to a piece of equipment required for testing.

2.1.1 Proprietary Equipment

Provide manufacturer's proprietary test equipment and software required by any equipment manufacturer for programming and start-up, whether specified or not. Provide manufacturer test equipment, demonstrate its use, and assist in the commissioning process as needed. Provide data logging equipment and software required to test equipment.

2.1.2 Calibration and Accuracy

Comply with equipment manufacturer's test equipment calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to Contracting Officer upon request.

Provide all testing equipment of sufficient quality and accuracy to test and measure system performance with the tolerances specified. Unless otherwise noted, the following minimum requirements apply: Provide temperature sensors and digital thermometers with a certified calibration within the past year to an accuracy of 0.5 degrees F and a resolution of plus or minus 0.1 degrees F. Provide pressure sensors with an accuracy of plus or minus 2.0 percent of the value range being measured (not full range of meter) and calibrated within the last year.

PART 3 EXECUTION

3.1 MEETINGS

Attend all meetings in accordance with Section 01 91 00.15 BUILDING COMMISSIONING.

Provide timely updates on construction schedule changes to allow the Lead Commissioning Specialist to execute commissioning process efficiently. Notify Contracting Officer of anticipated construction delays to commissioning activities not yet performed or not yet scheduled.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2 COMMISSIONING CONSTRUCTION OBSERVATION CHECKLISTS

Commissioning construction observation checklists include Pre-Functional Checklists, Integrated Systems Test Checklists, and Functional Performance Test Checklists. Provide commissioning construction observation checklists for the Interim and Final Construction Phase Commissioning Plan in accordance with Section 01 91 00.15 BUILDING COMMISSIONING.

Download example Pre-Functional Checklists, Integrated Systems Test Checklists, and Functional Performance Test Checklists for Section 01 91 00.15 BUILDING COMMISSIONING at the following location:
<https://www.wbdg.org/dod/ufgs/forms-graphics-tables>. The checklists submitted in the Interim and Final Construction Phase Commissioning Plans must contain the same level of detail shown in the examples. The submitted checklists are not required to match the format of the examples.

3.2.1 Pre-Functional Checklists

The Pre-Functional Checklists must include items for physical inspection or testing that demonstrate that installation and start-up of equipment and systems is complete. Refer to paragraph PRE-FUNCTIONAL CHECKS. Pre-functional checklists must be tailored to verify the specific installation requirements and details of the construction documents and manufacturer's instructions.

3.2.2 Functional Performance Test Checklists

Functional Performance Test Checklists must include procedures that explain, step-by-step, the actions and expected results that will demonstrate that the system performs in accordance with the contract and Owner's Project Requirements Document. Refer to paragraph FUNCTIONAL PERFORMANCE AND INTEGRATED SYSTEMS TESTING. Include the following sections and details appropriate to the systems being tested in the Functional Performance Test Checklists:

- a. Notable system features including information about controls to facilitate understanding of system operation and maintenance
- b. Conclusions and recommendations. Conclusions must clearly indicate if system does or does not perform in accordance with contract requirements and specifications and Owner's Project Requirements Document. Recommendation must clearly indicate that the system should or should not be approved by the Government.
- c. Test conditions including date, beginning and ending time, and beginning and ending outdoor air conditions
- d. Attendees
- e. Identification of the equipment involved in the test
- f. **System feature identification**
- g. Point-to-point observations including demonstrating system flow meters and sensors have been calibrated and are correctly displayed on the Operator work station

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- h. Actuator operation observations demonstrating actuator responses to commands from the control system
- i. As-found condition of the system operation
- j. List of test items with step numbers along with the corresponding feature or control operation, intended test procedure, expected system response, and pass/fail indication.
- k. Space for comments for each test item.

3.2.3 Integrated Systems Test Checklists

Integrated Systems Test Checklists must include test procedures that explain, step-by-step, the actions and expected results that will demonstrate that the interactive operations between systems performs in accordance with the contract and Owner's Project Requirements Document. Refer to paragraph FUNCTIONAL PERFORMANCE AND INTEGRATED SYSTEMS TESTING. Include the following sections in the Integrated Systems Test Checklists:

- a. Notable features of the interconnected systems organized by discipline including information to facilitate understanding of system operation
- b. Conclusions and recommendations. Conclusions must clearly indicate if the systems do or do not perform in accordance with contract requirements and specifications and the Owner's Project Requirements Document. Recommendation must clearly indicate that the systems should or should not be approved by the Government
- c. Test conditions including date and beginning and ending time
- d. Identification of the equipment and systems involved in the test
- e. List of test items with step numbers along with the corresponding feature or control operation, intended test procedure, expected system response, and pass/fail indication.
- f. Space for comments for each test item.

3.3 PRE-FUNCTIONAL CHECKS

Pre-Functional Checks are a type of Commissioning Inspection in accordance with Section 01 91 00.15 BUILDING COMMISSIONING. Complete one Pre-Functional Checklist for each individual item of equipment or system for each system required to be commissioned including, but not limited to, ductwork, piping, equipment, fixtures, and controls. Include manufacturer start-up checklists associated with equipment with the submission of the Pre-Functional Checklists. Provide manufacturer's installation manual for each type of unit. Indicate commissioning team member inspection and validation of each Pre-Functional Checklist item by initials. Validation of each Pre-Functional Checklist item by each team member indicates that item conforms to the contract documents and validated design in their area of responsibility. Validation of each item by each team member must occur immediately following completion of their respective duties related to the item. Commissioning Specialist validation of each Pre-Functional Checklist item indicates that each item has been installed correctly and in accordance with contract documents and the Owner's Project Requirements Document. Required commissioning team members for Pre-Functional Checks includes the CxC, Mechanical Commissioning Specialist, Quality Control

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Manager, sub-contractor representative for each trade responsible for construction/installation of the checklist item, and the TAB representative (for items impacting TAB). Submit the initialed and Completed Pre-Functional Checklists no later than 7 calendar days after completion of inspection of all checklist items for each system.

3.4 STARTUP AND INITIAL CHECKOUT

Document start-up and initial testing procedures, and include in the Completed Pre-Functional Checklists submittal, including:

- a. Startup tests and factory testing reports.
- b. Manufacturer's representative start-up, operating, troubleshooting and maintenance procedures.
- c. Perform and clearly document system operational checks and quality control checks as they are completed, and providing a copy to the commissioning team.
- d. Correct deficiencies and sign the Certificate of Readiness for each system before functional performance testing

3.5 DUCT AIR LEAKAGE TEST (DALT) REPORT REVIEW AND VERIFICATION

3.5.1 Duct Air Leakage Test (DALT) Report Review

The Mechanical System Technical Commissioning Specialist must review the pre-final DALT Report required by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. All deficiencies must be resolved prior to DALT Report approval.

3.5.2 NOT USED

3.6 TESTING, ADJUSTING, AND BALANCING REPORT REVIEW AND VERIFICATION

3.6.1 Testing, Adjusting, and Balancing (TAB) Report Review

The Mechanical System Technical Commissioning Specialist must review the pre-final TAB Report required by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. All deficiencies must be resolved prior to TAB Report approval.

3.6.2 NOT USED

3.7 HVAC CONTROLS START-UP AND PERFORMANCE VERIFICATION TEST REVIEW

The Mechanical System Technical Commissioning Specialist must review the Start-Up Testing Report, PVT Procedures and PVT Reports, including endurance testing trend submittals, required by Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. The Mechanical System Technical

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Commissioning Specialist must review each submittal and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. All deficiencies must be resolved prior to final acceptance.

3.8 FUNCTIONAL PERFORMANCE AND INTEGRATED SYSTEMS TESTING

Functional Performance and Integrated Systems Testing are a type of Commissioning Testing in accordance with Section 01 91 00.15 BUILDING COMMISSIONING. Conduct Functional Performance Testing in accordance with Section 01 91 00.15 BUILDING COMMISSIONING and requirements in this Section. Prior to Functional Performance Testing, complete all prerequisites in accordance with paragraph SEQUENCING AND SCHEDULING. Demonstrate that all system components have been installed, that each control device and item of equipment operates, and that the systems operate and perform, including interactive operation between systems, in accordance with contract documents and the Owner's Project Requirements Document.

Perform Integrated Systems Tests only after the Functional Performance Tests for each associated system are completed with all deficiencies resolved and after the related Functional Performance Test Checklists have been signed by each commissioning team member.

3.8.1 Test Scheduling and Coordination

Schedule and conduct Initial Functional Performance Tests. Develop and implement means of artificial loading to demonstrate, to a reasonable level of confidence, the ability of the HVAC systems to handle peak seasonal loads. Schedule Functional Performance Tests for each system only after the Certificate of Readiness has been approved by the Government for the system. Correct all deficiencies identified through any prior review, inspection, or test activity before the start of Functional Performance Tests.

Functional Performance Tests and Integrated Systems Tests must be performed with the CxC present. Government reserves the right to witness all tests. Coordinate test schedule with Government representatives.

3.8.2 Preparation

Put equipment and systems into operation and continue operation during each working day of functional performance and integrated systems testing, as required. Verify temperature and pressure taps in accordance with Contract Documents. Provide a pressure/temperature plug at each water sensor which is an input point to control system.

Perform minor adjustments to equipment and systems during Functional Performance Tests as deemed necessary by the commissioning team. Where calibrated DDC sensors cannot be used to record test data, provide measuring instruments, logging devices, and data acquisition equipment to record data for the complete range of test data for the required test period.

3.8.3 Testing Procedures

Provide all necessary materials and system modifications to produce the necessary flows, pressures, temperatures, and other conditions necessary to execute the test according to the specified conditions. At completion

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

of the test, return the affected building equipment and systems to their pre-test condition.

Follow the Functional Performance Test from the approved Final Construction Phase Commissioning Plan. Perform Functional Performance Tests for each item of equipment and each system required to be commissioned. Verify all sensor calibrations, control responses, safeties, interlocks, operating modes, sequences of operation, capacities, and all other performance requirements comply with contract, regardless of the specific items listed within the checklists provided. In general, testing must progress from equipment or components to subsystems to systems to interlocks and connections between systems. Commissioning Specialists are responsible for determining the order of components and systems to be tested.

Indicate validation of each item of equipment and systems tested by signature of each commissioning team member for each test. The Quality Control Representative, Commissioning Specialists, and Contracting Officer's Representative, if present, must indicate validation after the equipment and systems are free of deficiencies.

3.8.4 Simulating Conditions

Functional performance testing is conducted by simulating conditions at control devices to initiate a control system response. Before testing, calibrate all sensors, transducers and devices. Over-writing control input values through the control system is not acceptable unless approved by the Contracting Officer. Perform each test under conditions that simulate actual conditions as close as is practically possible. Specific examples of simulating conditions are provided below. Do not simulate conditions when damage to the system or building may result.

- a. When varying static pressures inside ductwork cannot be simulated within the duct, and where a sensor signals the controls system to initiate sequences at various duct static pressures, it is acceptable to simulate the various pressures with a Pneumatic Squeeze-Bulb Type Signaling Device with gauge temporarily attached to the sensing tube leading to the transmitter. It is not acceptable to reset the various set-points, nor to simulate an electric analog signal (unless approved as noted above).
- b. Dirty filter pressure drops can be simulated by partially blocking filter face.
- c. Freeze-stat safeties can be simulated by packing portion of sensor with ice.
- d. High outside air temperatures can be simulated with a hair blower.
- e. Raising entering cooling coil temperatures by activating a heating/preheat coil can be used to simulate entering cooling coil conditions.
- f. Do not use signal generators to simulate sensor signals unless approved by the Contracting Officer, as noted above, for special cases.
- g. Control set points can be altered. For example, to see the air conditioning compressor lockout work at an outside air temperature below 55 degrees F, when the outside air temperature is above 55

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

degrees F, temporarily change the lockout set point to be 0 degrees F above the current outside air temperature. Caution: Set points are not to be raised or lowered to a point to cause damage to the components, systems, or the building structure and contents.

- h. Test duct mounted smoke detectors in accordance with the manufacturer's recommendations. Perform the tests with air system at minimum airflow condition.
- i. Test current sensing relays used for fan and pump status signals to control system to indicate unit failure and run status by resetting the set point on the relay to simulate a lost belt or unit failure while the unit is running. Confirm that the failure alarm was generated and received at the control system. After the test is conducted, return the set point to its original set-point or a set-point as indicated by the Contracting Officer.

3.8.5 Manufacturer's Representative

Provide a factory trained representative authorized by the equipment manufacturer to perform Functional Performance Testing for the following equipment:

Chillers

Ensure the test representative reviews, approves, and signs the completed field test report. Include person's name with signatures.

3.8.6 Integrated Systems Tests

Follow the Integrated Systems Test Checklists from the approved Final Construction Phase Commissioning Plan. Integrated Systems Tests must be performed for the interactive operation between HVAC systems and other systems such as fire protection systems, smoke control systems, or back-up electrical supply. Verify correct interactive operation, acceptable speed of response, and other contract requirements for both normal and failure modes. Examples of Integrated Systems Tests include the correct operation of HVAC systems during emergency system activation or correct operation of uninterruptible power supplies or energy generators and connected systems.

3.8.7 Sample Strategy

Perform Functional Performance Tests using the following sample strategy. Refer to Section 01 91 00.15 BUILDING COMMISSIONING for sample strategy. Complete a Functional Performance Test Checklist for each item of equipment or system to be tested. During testing, Government representatives may select the specific equipment or system to be tested for sample sizes less than 100 percent. Equipment Identifiers are as indicated on the design drawings:

Equipment Identifier	Sample Size (Percent)
AHU	100
VAV	100
CWP	100

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

DWH

100

Perform Integrated Systems Tests and complete an Integrated Systems Test Checklist for for all (100 percent) systems and equipment having interactive operation.

3.8.7.1 100 Percent Sample Procedures

Systems or equipment for which 100 percent sample size are tested fail if one or more of the test procedures results in discovery of a deficiency and the deficiency cannot be resolved within 5 minutes during the test.

Re-test to the extent necessary to confirm that the deficiencies have been corrected without negatively impacting the performance of the rest of the system.

3.8.7.2 Less than 100 Percent Sample Procedures

Randomly test each sample group of identical equipment. If 10 percent of the units in the first sample fail the functional performance tests, test a second sample group, the same size as the first sample group. The second sample must not include any units from the first sample group.

If 10 percent of the units in the second sample fail, test all remaining units. If at any point frequent failures occur the CxC may stop the testing and require the contractor to perform and document a checkout of the remaining units prior to continuing functional testing.

3.9 INTEGRATED SYSTEMS TEST

Perform Integrated Systems Tests only after the Functional Performance Tests for each associated system are completed with all deficiencies resolved and after the related Functional Performance Test Checklists have been signed by each commissioning team member.

3.10 RETESTING REQUIREMENTS

Abort tests if any deficiency prevents successful completion of the test or if any required commissioning team member is not present for the test. Re-test only after all deficiencies identified during the original tests have been corrected.

Contracting Officer may withhold payment equivalent to lost time, re-testing, and aborted tests. These costs may include salary, travel costs, and per diem for Government team members. Correct deficiencies as identified by the commissioning team and retest the systems to be commissioned.

3.11 SYSTEM ACCEPTANCE

Systems may be partially accepted prior to seasonal testing if they comply with all construction contract and accepted design requirements that can be tested during initial Functional Performance Tests. All test procedures must be successful completed prior to full systems acceptance.

3.12 SEASONAL TESTS

Perform Initial Functional Performance Tests as soon as all contract work

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

is completed, but prior to facility turnover, regardless of the season.

In addition to the Initial Functional Performance Tests, perform Functional Performance Tests of HVAC systems during peak heating and cooling seasons during outdoor air condition design extremes. Schedule Seasonal Functional Performance Tests in coordination with the Contracting Officer. Submit Seasonal Test Report within 14 days of test completion. Include seasonal test report in the Updated Final Commissioning Report as specified in Section 01 91 00.15 BUILDING COMMISSIONING

Execute seasonal functional performance testing, witnessed by the Contracting Officer. Correct deficiencies and make adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

3.13 NOT USED

3.14 TRAINING

The Mechanical Systems Technical Commissioning Specialist must review the training plan required by Section 01 78 00 OPERATION AND MAINTENANCE DATA and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel.

3.15 COMMISSIONING REPORT

Include all completed Pre-Functional Checklists and Functional Performance and Integrated Systems Test Checklists in the Commissioning Report as specified in Section 01 91 00.15 BUILDING COMMISSIONING. Include the approved TAB Report.

3.16 POST-CONSTRUCTION ENDURANCE TEST

Perform an Endurance Test in accordance with the paragraph ENDURANCE TEST in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC once during the peak heating season and once during the peak cooling season during outdoor air condition extremes with the exception that network bandwidth usage measurement and recording is not required.

The Mechanical System Commissioning Specialists must review the trend logs from the Endurance Tests to ensure that the systems have stable operation and operate as required by the construction contract, the accepted design, and the Owner's Project Requirements Document. The Commissioning Specialists must provide a Post-Construction Trend Log Report that identifies any deficiencies noted in operation, recommendations for correction, and includes a graphical representation of the trends. Provide one Trend Log Report for the peak cooling season and one Trend Log Report for the peak heating season. Submit the Post-Construction Trend Log Reports no later than 14 calendar days following receipt of the trend log data by the Commissioning Specialist. Include the Post-Construction Trend Log Reports in the Updated Final Commissioning Report as specified in Section 01 91 00.15 BUILDING COMMISSIONING

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

08/24, CHG 1: 08/25

PART 1 GENERAL

1.1 SUMMARY

Provide a complete Direct Digital Control (DDC) system, except for the Front End which is specified in Section 25 10 10 UTILITY MONITORING AND CONTROL (UMCS) FRONT END AND INTEGRATION, 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 93 SEQUENCES OF OPERATION FOR HVAC CONTROL, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS, Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL 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 a proprietary

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 functionality 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 3 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 Information and Conformance Statement (NICS) which allows open access as defined by Niagara NICS with 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.
- b. Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
- c. Section 23 09 93 SEQUENCES OF OPERATIONS FOR HVAC CONTROLS
- d. Section 25 08 10 UTILITY MONITORING AND CONTROL SYSTEMS TESTING
- e. Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS
- f. Section 23 81 00 DECENTRALIZED UNITARY HVAC EQUIPMENT
- g. Section 01 91 00.15 BUILDING COMMISSIONING

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 (2024; INT 1-3 2025; Errata 1 2025; INT 4-6 2025; Addenda CU 2025) BACnet—A Data Communication Protocol for Building Automation and Control Networks

ASHRAE FUN IP (2021; CORR 2023) Fundamentals Handbook, I-P 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 1 2024; TIA 24-1; TIA 25-2) National Electrical Code

NFPA 90A (2024) Standard for the Installation of Air Conditioning and Ventilating Systems

TRIDIUM, INC (TRIDIUM)

Niagara Framework (2021) NiagaraAX User's Guide

Niagara NICS (2022) Niagara Information and Conformance Statement

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

UL SOLUTIONS (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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

Definitions including "(BACnet)" after the term are definitions derived from ASHRAE 135.

1.4.1 Alarm Generation

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) - see paragraph ALARM ROUTING in Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION.

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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)

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

The following is a list of some BIBBs used by this or referenced Sections:	
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)
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

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

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4.19 Building Control Network (BCN)

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

1.4.20 Building Point of Connection (BPOC)

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

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

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.

- a. In a non-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
- b. 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

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

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)

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)

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

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. Some devices contain both gateway and control functions; these devices are considered both gateways and digital controllers and must meet the requirements for both.

A Niagara Framework Supervisory Gateway is one type of Gateway.

1.4.33 IEEE 802.3 Ethernet

A family of local-area-network technologies providing high-speed networking features over various media, typically Cat 5, 5e or Cat 6

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

twisted pair copper or fiber optic cable.

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

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)

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

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

1.4.37 IP subnet

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)

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

1.4.40 Local Display Panels (LDPs)

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

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

1.4.42 Multidrop Serial Bus/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

The UMCS 'front end' software which performs supervisory functions such as

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4.51 Operator Configurable

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.

For non Niagara-based BACnet systems, a property, setting, or value in a device is Operator Configurable when it is Configurable and is either:

- a. a Writable Property of a Standard BACnet Object; or
- b. a Property of a Standard BACnet Object that is Writable when Out_Of_Service is TRUE and Out_Of_Service is Writable.

1.4.52 Overridable (Point)

A point is Overridable if it can be Overriden (See Override).

1.4.53 Override

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).

1.4.54 Packaged Equipment

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.

1.4.55 Packaged Unit

See packaged equipment.

1.4.56 Performance Verification Test (PVT)

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4.57 Physical Segment (BACnet)

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

1.4.58 Polling

A device periodically requesting data from another device.

1.4.59 Points

Physical inputs and outputs, and virtual values read from or written to a controller over the the network. See also paragraph INPUT/OUTPUT (I/O).

1.4.60 Proportional, Integral, and Derivative (PID) Control Loop

A closed-loop control algorithm calculating control output based using the error between a process variable and setpoint. The proportional control component adjusts control output based on the current error, the integral component adjusts based on a sum of errors over time, and the derivative component adjusts based on the rate of change of the errors. Not all components are employed in all implementation of a PID loop, and when a component is not used the corresponding letter is generally dropped from the abbreviation used for that control. For example derivative control is often not required for HVAC systems, leaving "PI" control.

1.4.61 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.

1.4.62 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.

1.4.63 Repeater

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

1.4.64 Router

Generically, a Router is a device that connects two or more networks and controls traffic between them by retransmitting signals received from one network onto another based on the signal destination.

As used in this Section, a Router connects two or more ASHRAE 135 networks and controls traffic between them by retransmitting signals received from one network onto another based on the signal destination. Routers are used to subdivide a BACnet internetwork and to limit network traffic.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4.65 Segment

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.

1.4.66 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.

1.4.67 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.

1.4.68 Standard BACnet Services (BACnet)

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

1.4.69 UMCS

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.

1.4.70 UMCS Network

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

1.4.71 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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
6	E	Start-Up and Start-Up Testing	ACO #5
7	S	Post-Construction QC Checklist	30 days ACO #6
8	S	Programming Software Configuration Software Niagara Framework Engineering Tool Niagara Framework Wizards	30 days ACO #6
9	S	Draft As-Built Drawings	30 days ACO #6
10	S	Start-Up Testing Report	30 days ACO #6

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE II. PROJECT SEQUENCING			
ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL)
11	S	PVT Procedures	_____ days before schedule start of #12 and AAO #10
12	S,E	Execute PVT PVT Testing Activities	AAO #9 and #11As indicated in PART 3 of this Section
13	S	PVT Report	30 days ACO #12 As indicated in PART 3 of this Section
14	S	Controller Application Programs Controller Configuration Settings Niagara Framework Supervisory Gateway Backups	30 days AAO #13
15	S	Final As-Built Drawings	30 days AAO #13
16	S	O&M Instructions	AAO #15
17	S	Training Documentation	AAO #10 and 30 days 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" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are 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:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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,

SD-05 Design Data

Boiler Or Chiller Plant Gateway Request

SD-06 Test Reports

Existing Conditions Report

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,

Control Contractor s Performance Verification Testing Plan; G

Equipment Supplier s Performance Verification Testing Plan; G

Endurance Testing Results; G

Performance Verification Test Report; G

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 3 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

user manuals for each software with the software submittal.

Submit Programming Software on CD-ROM as a Technical Data Package.
Submit 2 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 2 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 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 Checklist for Niagara Framework Based BACnet Systems in APPENDIX A of this Section must be completed by the Contractor's Chief Quality

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 -35 to +151 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

Wireless capabilities must comply with Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS

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 3 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 EXISTING CONDITIONS

3.1.1 Existing Conditions Survey

Perform a field survey, including testing and inspection of the equipment to be controlled and submit an Existing Conditions Report documenting the current status and its impact on the Contractor's ability to meet this specification. For those items considered nonfunctional, document the

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

deficiency in the report including explanation of the deficiencies and estimated costs to correct the deficiencies. As part of the report, define the scheduled need date for connection to existing equipment. Make written requests and obtain Government approval prior to disconnecting any controls and obtaining equipment downtime.

Submit four copies of the Existing Conditions Report.

3.1.2 Existing Equipment Downtime

Make written requests and obtain Government approval prior to disconnecting any controls and obtaining equipment downtime.

3.1.3 Existing Control System Devices

Inspect, calibrate, and adjust as necessary to place in proper working order all existing devices which are to be reused.

3.2 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, and this Section.

3.2.1 Dielectric Isolation

Provide dielectric isolation where dissimilar metals are used for connection and support. Install control system in a manner 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.

3.2.2 Penetrations in Building Exterior

Make all penetrations through and mounting holes in the building exterior watertight.

3.2.3 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.

3.2.4 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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

3.2.5 Surge Protection

3.2.5.1 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.

3.2.5.2 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.

3.2.6 Basic Cybersecurity Requirements

3.2.6.1 Passwords

Password development and the Password Summary Report submittal must comply with Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS.

3.2.6.2 Wireless Capability

Wireless capabilities must comply with Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS.

3.2.6.3 IP Network Physical Security

IP network physical security must comply with Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS.

3.3 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 ISO A1 34 by 22 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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: 2 hard copies and 2 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: 2 hard copies and 2 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: 2 hard copies and 2 copies on CD-ROM.

3.3.1 Sample Drawings

Sample drawings in electronic format are available at the Whole Building Design Guide page for this section:

<https://www.wbdg.org/dod/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.

3.3.2 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.

3.3.3 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.

3.3.4 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.

3.3.5 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

3.3.6 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.

3.3.7 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.

3.3.8 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.

3.3.9 DDC Hardware Schedule

Provide a single DDC Hardware Schedule for the entire project and including following information for each device.

3.3.9.1 DDC Hardware Identifier

The Unique DDC Hardware Identifier for the device.

3.3.9.2 HVAC System

The system "name" used to identify a specific system (the name used on the system schematic drawing for that system).

3.3.9.3 BACnet Device Information

3.3.9.3.1 Device Object Identifier

The Device Object Identifier: The Object_Identifier of the Device Object

3.3.9.3.2 Network Number

The Network Number for the device.

3.3.9.3.3 MAC Address

The MAC Address for the device

3.3.9.3.4 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.3.9.3.5 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.

3.3.9.3.6 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.

3.3.9.3.7 Scheduling Information

Indicate whether the device is used for scheduling.

3.3.9.3.8 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.

3.3.9.4 Niagara Station ID

The Niagara Station ID for each Niagara Framework Supervisory Gateway

3.3.10 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:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.3.10.1 Point Name

The abbreviated name for the point using the indicated naming convention.

3.3.10.2 Description

A brief functional description of the point such as "Supply Air Temperature".

3.3.10.3 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.

3.3.10.4 Settings

The value and units of any setpoints, configured setpoints, configuration parameters, and settings related to each point.

3.3.10.5 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.

3.3.10.6 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.

3.3.10.7 Object and Property Information

The Object Type and Instance Number for the Object associated with the

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

3.3.10.8 Niagara Station ID

The Niagara Station ID of the Niagara Framework Supervisory Gateway the point is mapped into.

3.3.10.9 Network Data Exchange Information (Gets Data From, Sends Data To)

Provide the DDC Hardware Identifier of other DDC Hardware the point is shared with.

3.3.10.10 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.

3.3.10.11 Trend Object Information

For each point requiring a trend, indicate if the trend is Local or Remote, the trend Object type and the trend Object instance number. For remote trends provide the DDC Hardware Identifier for the device containing the trend Object in the Points Schedule notes.

3.3.10.12 Alarm Information

Indicate the Alarm Generation Type, Event Enrollment Object Instance Number, and Notification Class Object Instance Number for each point requiring an alarm. (Note that not all alarms will have Event Enrollment Objects.)

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.)

3.3.10.13 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.3.11 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.

3.3.12 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.

3.3.13 Sequences of Operation Including Control Logic Diagrams

Provide HVAC control system sequence of operation and control logic diagrams in the same format as the Contract Drawings. Within these drawings, refer to devices by their unique identifiers. Submit sequences of operation and control logic diagrams for each HVAC system

3.3.14 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.

3.4 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.5 START-UP

3.5.1 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.

3.5.1.1 Systems Check

An item-by-item check must be performed for each HVAC system

3.5.1.1.1 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.

3.5.1.1.2 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.

3.5.1.1.3 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.

3.5.1.2 Weather Dependent Test

Perform weather dependent test procedures in the appropriate climatic season.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.5.2 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).

3.6 PERFORMANCE VERIFICATION TEST (PVT)

3.6.1 PVT Procedures

Prepare PVT Procedures based on Section 25 08 10 UTILITY MONITORING AND CONTROL SYSTEM TESTING 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.

3.6.1.1 Sensor Accuracy Checks

Include a one-point accuracy check of each sensor in the PVT procedures.

3.6.1.2 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 BACnet Trend Log or Trend Log Multiple 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.

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.

Use the existing trending capabilities as indicated to trend all points shown as requiring a trend on the Point Schedule for the entire endurance test.

3.6.1.3 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

3.6.2 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

3.6.3 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.

3.7 PERFORMANCE VERIFICATION TESTING

3.7.1 General

PVT testing must demonstrate compliance of controls work with contract document requirements and must be performed by the Controls Contractor and Equipment Suppliers. No less than 14 calendar days prior to start of controls system installation, meet with the Contracting Office's technical representative (COTR) and the designing engineer of the HVAC systems, the Contractor's QA representative, the Contractor's Controls Contractor representative, and the control system Owner to develop a mutual understanding relate to the details of the PVT work requirements, including required submittals, work schedule, and field quality control.

3.7.2 Performance Verification Testing and Commissioning

PVT testing is a Government quality assurance function that includes systems trending and field tests. Commissioning is a quality control function that is the Commissioning Team's responsibility to the extent required by this contract.

3.7.3 Performance Verification Testing of Equipment with Packaged Controls

Controls Contractor and Equipment Supplier(s) must share and coordinate PVT testing responsibilities for equipment provided with on-board factory packaged controls such as boiler controllers, dedicated outside air systems (DOAS s), and packaged pumping systems.

3.7.3.1 Controls Contractor Responsibilities

The Controls Contractor must provide a PVT Plan separate from Equipment Supplier's performance verification testing plan, perform endurance testing, and perform PVT testing concurrent with Equipment Suppliers testing for equipment provided with on-board factory packaged controls to demonstrate the following:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- a. Equipment enabling and disabling.
- b. Equipment standard and optional control points necessary to accomplish functionality regardless if specified in contract documents or not.
- c. Equipment standard and optional alarms critical to safe operation regardless if specified in contract documents or not.
- d. All control points added by Controls Contractor in addition to onboard factory packaged controls regardless if specified in contract documents or not.

Refer to paragraphs titled Performance Verification Test Plan and Endurance Testing for additional information.

3.7.3.2 Equipment Supplier Responsibilities

Each Equipment Supplier must provide PVT Plans separate from Controls Contractor s plans and perform PVT testing concurrent with Controls Contractor s testing for their equipment provided with on-board factory packaged controls to demonstrate the following:

- a. Equipment standard and optional control features necessary to accomplish functionality regardless if specified in contract documents or not.
- b. Equipment standard and optional operation modes necessary to accomplish functionality regardless if specified in contract documents or not.
- c. Equipment standard and optional alarm conditions for safe operation regardless if specified in contract documents or not.

Refer to all paragraphs under paragraph titled Performance Verification Testing except for section titled Endurance Testing for additional information.

3.7.4 Sequencing of Performance Verification Testing Activities

PVT activities must be sequenced with major activities listed below for Test and Balance (TAB) Contractor, Equipment Suppliers, Commissioning Specialists, and others to demonstrate fully functioning systems. Refer to Section 01 32 17.00 20 COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS). Complete the items in TABLE III: SEQUENCING OF PVT TESTING ACTIVITIES as schedule activities or milestones.

TABLE III: SEQUENCING OF PVT TESTING ACTIVITIES	
SEQUENCE	ITEM
1	Submission, review, and approval of Control Contractors PVT Plans.
2	Submission, review, and approval of Equipment Suppliers PVT Plans.
3	Submission, review, and approval of certified final Test and Balance Report.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE III: SEQUENCING OF PVT TESTING ACTIVITIES	
SEQUENCE	ITEM
4	Conduct commissioning functional performance tests.
5	Submission, review, and approval of all of the Commissioning Specialists completed functional performance tests.
6	Request Contracting Officer to allow beginning of Government-witnessed PVT testing.
7	Contracting Officers approval to begin PVT testing.
8	Conduct PVT field work.
9	Governments verbal approval of PVT field work for all systems.
10	Conduct Test and Balance verification field work.
11	Governments written approval of Test and Balance verification field work.
12	Submission, review, and approval of endurance testing.
13	Governments written approval of PVT field work for all systems.
14	Facility acceptance recommendation.
15	Submission, review, and approval of Control Contractors PVT Report.
16	Submission, review, and approval of Equipment Suppliers PVT Report.
17	Conduct applicable re-testing and seasonal testing within 10 months of beneficial occupancy.

3.7.4.1 PVT Testing for Multi-Phase Construction

For air moving systems except outside air systems serving multiple phases, all major activities listed in TABLE III through Government s verbal approval of Test and Balance verification field work can be completed by phase if all ductwork construction is completed for that phase.

For primary systems such as chilled water systems, HVAC heating hot water systems, and outside air systems serving multiple phases, all major activities listed listed in TABLE III through Government s verbal approval of Test and Balance verification field work for all air moving systems served by that primary system for that phase must be completed prior to conducting PVT field work for that primary system.

3.7.5 Control Contractor's Performance Verification Testing Plan

Submit a detailed PVT Plan of the proposed control systems testing in this contract for approval prior to its use. Develop and use a single PVT Plan for each system with a unique control sequence. Systems sharing an identical control sequence can be tested using copies of the PVT Plan intended for these systems.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

PVT Plans must include system-based, step-by-step test methods demonstrating system performs in accordance with contract document requirements. The Government may provide sample PVT Plans upon request. PVT Plans must include the following:

- a. Control sequences from contract documents segmented such that each control algorithm, operation mode, and alarm condition is immediately followed by numbered test methods required to initiate a response, expected response, space for comments, and "pass" or "fail" indication for each expected response.
- b. PVT Plans with control sequences from contract documents that are not segmented into parts will not be accepted.
- c. Indication where assisting personnel are required such as Mechanical Contractor.
- d. Signature and date lines for the Contractor's PVT administrator, Contractor's quality assurance representative, and Contracting Officer's representative acknowledging completion of testing.

3.7.6 Performance Verification Testing Sample Size

PVT testing sample sizes will be as follows:

- a. 100-Percent of the following systems:
 - (1) primary systems including, but not limited to, chilled water and HVAC heating hot water systems
 - (2) air handling unit systems including all associated fans except for remote exhaust air fans
 - (3) DOAS s including all associated fans except for remote exhaust air fans
- b. 20-Percent of each set of systems with a shared identical control sequence for systems such as:
 - (1) air terminal units
 - (2) exhaust air fans
 - (3) terminal equipment such as fan coil units and unit heaters

3.7.6.1 Selection of Systems to Test

For sample sets less than 100-percent, the Government will choose which systems will be tested. The Government may require additional testing if previous testing results are inconsistent or demonstrate improper system control as follows:

- a. An additional 25-percent after five-percent failure rate of first sample set.
- b. 100-percent after any failures occurring in additional sample set.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.7.7 Conducting Performance Verification Testing

At least 15 days prior to preferred test date, request the Contracting Officer to allow the beginning of Government-witnessed PVT testing. Provide an estimated time table required to perform testing of each system. Furnish personnel, equipment, instrumentation, and supplies necessary to perform all aspects of testing. Testing personnel must be regularly employed in the testing and calibration of control systems. After receipt of Contracting Officer's approval to begin testing, perform PVT testing using project's as-built (shop) control system drawings, project's design drawings, and approved PVT Plans.

During testing, identify deficiencies that do not meet contract document requirements. Deficiencies must be investigated, corrected with corrections documented, and re-tested at a later date following procedures for the initial PVT testing. The Government may require re-testing of any control system components affected by the original failed test.

3.7.8 Endurance Testing

3.7.8.1 General

Conduct endurance testing in conjunction with the PVT to demonstrate control loop stability and accuracy. For all control loops tested, record trend data of the control variables over time, demonstrating that the control loop responds to a sudden change of the control variable set point without excessive overshoot or undershoot. Conduct endurance testing for each system subject to PVT testing. Systems must be operating as normally anticipated during occupancy throughout endurance testing.

Endurance testing results must clearly demonstrate control loop stability and accuracy. Controlled loop outputs must be stable and accurately maintain each setpoint.

3.7.8.2 Hardware

Use hardware provided in this contract for testing.

If insufficient buffer capacity exists to trend the entire endurance test, upload trend data during the course of endurance testing to ensure all trend data is retained. Lost trend data will require retesting of all control points for affected system(s).

3.7.8.3 Endurance Testing Results Format

Submit endurance testing results for each tested system in a graphical format complete with clear indication of value(s) for y-axis, value for x-axis, and legend identifying each trended control point. The number of control points contained on a single graph must be such that all control points can be clearly visible. Control points must be logically grouped such that related points appear on a single graph. In addition, submit a separate comma separated value (CSV) file of raw trend data for each trended system. Each trended control point in CSV file must be clearly identified.

For control points recorded based on change of value, change of value for recording data must be clearly identified for each control point.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.7.8.4 Endurance Testing Start, Duration, and Frequency

Trending of all control points for a given system must start at an identical date and time regardless of the basis of data collection. Duration of all endurance tests must be at least one-week.

Unless specified otherwise for control points recorded based on time, frequency of data collection must be 15-minutes . Frequency of data collection for specific types of control points is as follows:

3.7.8.4.1 Points Trended at One Minute Intervals

- a. Temperature for supply air, return air, mixed air, supply water, and return water
- b. Temperature for outside air, supply air, return air and exhaust air entering and leaving energy recovery device
- c. Flow for supply air, return air, outside air, chilled water, and HVAC heating hot water
- d. Flow for exhaust air associated with energy recovery
- e. Relative humidity for outside air and return air
- f. Relative humidity for outside air, supply air, return air and exhaust air entering and leaving energy recovery device
- g. Command and status for control dampers and control valves
- h. Speed for fans and pumps
- i. Pressure for fans and pumps

3.7.8.4.2 Points Trended at 15 Minute Intervals

- a. Temperature and relative humidity for zones
- b. Temperature and relative humidity for outside air not associated with energy recovery
- c. Command and status for equipment
- d. Pressure relative to the outside for facility

3.7.8.5 Trended Control Points

Trended control points for each system must demonstrate each system performs in accordance with contract document requirements. Trended control points must include, but not be limited to, control points listed in contract document points list.

Minimum control points that are required to be trended for selected systems are listed below. These control points must be trended as applicable to this contract in addition to control points necessary to demonstrate systems perform in accordance with contract document requirements and those listed in contract document s points list.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.7.8.5.1 Air-Cooled Chiller Chilled Water System.

- a. Chiller(s) command and status
- b. Chiller isolation valve(s) command and status
- c. Chilled water pump(s) actual speed
- d. Chilled water pump(s) setpoint and actual differential pressure
- e. Minimum flow bypass control valve command
- f. Minimum system flow setpoint and actual flow
- g. Chilled water supply setpoint and actual temperature
- h. Chilled water return actual temperature
- i. Chilled water actual flow
- j. Outside air actual dry-bulb temperature

3.7.8.5.2 HVAC Heating Hot Water System with Boiler.

- a. Boiler(s) command and status
- b. Boiler(s) isolation valve command and status
- c. HVAC heating hot water pump(s) actual speed
- d. HVAC heating hot water pump(s) setpoint and actual differential pressure
- e. Minimum flow bypass control valve command
- f. Minimum system setpoint and actual flow
- g. HVAC heating hot water supply setpoint and actual temperature
- h. HVAC heating hot water return actual temperature
- i. HVAC heating hot water actual flow
- j. Outside air actual dry-bulb temperature

3.7.8.5.3 NOT USED

3.7.8.5.4 Air Handling Unit with Relief Air Fan

- a. Outside air actual dry-bulb temperature
- b. Outside air actual relative humidity
- c. Outside air setpoint and actual airflow
- d. Minimum outside air control damper command

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- e. Economizer outside air control damper command
- f. Facility setpoint and actual relative pressure
- g. Return air actual dry-bulb temperature
- h. Return air actual relative humidity
- i. Return air control damper command
- j. Relief air control damper command
- k. Relief air fan actual speed
- l. Mixed air setpoint and setpoint and actual temperature
- m. Preheat coil leaving air setpoint and actual temperature
- n. Preheat coil control actuator command
- o. Cooling coil leaving air setpoint and actual temperature
- p. Cooling coil control valve command
- q. Supply air fan actual speed
- r. Discharge air actual temperature
- s. Supply air fan setpoint and actual static pressure

3.7.8.5.5 NOT USED

3.7.8.5.6 NOT USED

3.7.8.6 Endurance Testing Sample Size

Endurance Testing sample sizes were as follows:

- a. 100-Percent of the following systems:
 - (1) primary systems including, but not limited to, chilled water and HVAC heating hot water systems
 - (2) air handling unit systems including all associated fans except for remote exhaust air fans
 - (3) DOAS s including all associated fans except for remote exhaust air fans
- b. 20-Percent of each set of systems with a shared identical control sequence for systems such as:
 - (1) air terminal units
 - (2) exhaust air fans

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

(3) terminal equipment such as fan coil units and unit heaters

3.7.8.6.1 Selection of Systems to Test

For sample sets less than 100-percent, the Government will choose which systems will be tested. The Government may require additional testing if previous testing results are inconsistent or demonstrate improper system control as follows:

- a. An additional 25-percent after five-percent failure rate of first sample set.
- b. 100-percent after any failures occurring in additional sample set.

3.7.9 Performance Verification Test Report

Submit a PVT Report after receiving Government's written approval of PVT field work that is intended to document test results and final control system sequences and settings prior to turnover. The PVT Report must contain the following:

- a. Executive summary that briefly discusses results of each system's endurance testing and PVT testing and conclusions for each system.
- b. Endurance testing for each system.
- c. Completed PVT Plan for each system used during testing that includes hand written field notes and participant signatures.
- d. Blank PVT Plan for each system approved prior to testing that is edited to reflect changes occurring during testing. Edits must be typed and must reflect changes to control sequences from contract documents, must reflect changes to numbered test methods required to initiate a response, and must reflect changes to expected response. Only one blank PVT Plan is required for each set of systems sharing an identical control sequence, such as air terminal units, exhaust air fans, fan coil units and unit heaters.
- e. Written certification that the installation and testing of all systems are complete and meet all contract document requirements.

3.8 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. "Data Package 4" as described in Section 01 78 23 OPERATION AND MAINTENANCE DATA for all air compressors.
- c. HVAC control system sequences of operation formatted as indicated.
- d. 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- e. As-built HVAC control system detail drawings formatted as indicated.
- f. 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.
- g. Qualified service organization list, including at a minimum company name, contact name and phone number.
- h. Start-Up Testing Report.
- i. 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.

3.9 NOT USED

3.10 TRAINING

Conduct a training course for 2 operating staff members designated by the Government in the maintenance and operation of the system, including specified hardware and software. Conduct 32 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.

3.10.1 Training Documentation

Prepare training documentation consisting of:

- a. Course Attendee List: Develop the list of course attendees in coordination with and signed by the HVAC 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.

3.10.2 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

3.10.3 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

APPENDIX A

<u>QC CHECKLIST FOR BACNET SYSTEMS</u>		
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.	____

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

<u>QC CHECKLIST FOR BACNET SYSTEMS</u>		
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 the standard BACnet Objects for these functions.	____
15	All Properties indicated as required to be Writable are Writable and Overrides have been provided as indicated	____
	(QC Representative Signature)	(Date)

<u>QC CHECKLIST FOR NIAGARA FRAMEWORK BASED BACNET SYSTEMS</u>		
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.	____

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

<u>QC CHECKLIST FOR NIAGARA FRAMEWORK BASED BACNET SYSTEMS</u>		
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.	____
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 Intrinsic 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 --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 01 30 00 ADMINISTRATIVE REQUIREMENTS

Section 23 30 00 HVAC AIR DISTRIBUTION

Section 23 05 15 COMMON PIPING FOR HVAC

Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|------------|--|
| ANSI C12.1 | (2014; Errata 2016) Electric Meters - Code
for Electricity Metering |
|------------|--|

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- | | |
|--------------|---|
| ASME B16.15 | (2024) Cast Copper Alloy Threaded Fittings
Classes 125 and 250 |
| ASME B16.34 | (2021) Valves - Flanged, Threaded and
Welding End |
| ASME B40.100 | (2022) Pressure Gauges and Gauge
Attachments |

ASTM INTERNATIONAL (ASTM)

- | | |
|-----------|--|
| ASTM A536 | (2024) Standard Specification for Ductile
Iron Castings |
|-----------|--|

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)

- | | |
|------------------|---|
| ANSI C12.20 | (2015; E 2018) Electricity Meters - 0.1,
0.2, and 0.5 Accuracy Classes |
| NEMA 250 | (2020) Enclosures for Electrical Equipment
(1000 Volts Maximum) |
| NEMA/ANSI C12.10 | (2011; R 2021) Physical Aspects of
Watthour Meters - Safety Standard |

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 1 2024; TIA 24-1) National Electrical Code
NFPA 90A	(2024) Standard for the Installation of Air Conditioning and Ventilating Systems

UL SOLUTIONS (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.

1.7 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph entitled CONTRACTOR SPECIAL REQUIREMENTS in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS.

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:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 -35 to +151 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 NOT USED

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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.

2.5.1.2 Liquid Service Above 150 Degrees F

- a. Two-position valves: Use either globe valves or ball valves except that butterfly valves may be used for sizes 4 inch and larger.
- b. Modulating valves: Use globe valves except that butterfly valves may be used for sizes 4 inch and larger.

2.5.1.3 Steam Service

Use globe valves except that butterfly valves may be used for sizes 4 inch and larger.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

2.5.4.2 Liquid Service Not Exceeding 250 Degrees F

a. Valve body and body connections:

- (a) 1) valves 1-1/2 inches and smaller: brass or bronze body, with threaded or union ends
- (b) 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 trim: Type 316 stainless steel including seats, seat rings, modulation plugs, valve stems, and springs.

c. Provide valves with non-metallic parts suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher.

d. Provide valves compatible with a solution of 50 percent ethylene or propylene glycol

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.5.4.3 Hot water service 250 Degrees F and above

- a. Provide valve bodies conforming to ASME B16.34 Class 300. For valves 1 inch and larger provide valves with bodies which are carbon steel, globe type with welded ends. For valves smaller than 1 inch provide valves with socket-weld ends. Provide valves with virgin polytetrafluoroethylene (PTFE) packing. Provide valve and actuator combinations which are normally closed.
- b. Internal trim: Type 316 stainless steel including seats, seat rings, modulation plugs, valve stems, and springs.

2.5.4.4 Steam Service

For steam service, provide valves meeting the following requirements:

- a. Valve body and connections:
 - (a) 1) valves 1-1/2 inches and smaller: complete body of brass or bronze, with threaded or union ends
 - (b) 2) valves from 2 inches to 3 inches inclusive: body of brass, bronze, or carbon steel
 - (c) 3) valves 4 inches and larger: body of carbon steel. 2 inch valves with threaded connections; valves 2-1/2 inches and larger with flanged connections.
- b. Internal Trim: Type 316 stainless steel including seats, seat rings, modulation plugs, valve stems, and springs.
- c. Valve sizing: sized for 15 psig inlet steam pressure with a maximum 12 psi differential through the valve at rated flow, except where indicated otherwise.

2.5.5 Ball Valves

2.5.5.1 Liquid Service Not Exceeding 150 Degrees F

- a. Valve body and connections:
 - (a) 1) valves 1-1/2 inches and smaller: bodies of brass or bronze, with threaded or union ends
 - (b) 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

2.5.8 Duct-Coil and Terminal-Unit-Coil Valves

For duct or terminal-unit coils provide control valves with either screw type or solder-type ends. Provide flare nuts for each flare-type end valve.

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 Section 23 09 23.01 LONWORKS DIRECT DIGITAL CONTROL FOR HVAC AND OTHER

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

BUILDING CONTROL SYSTEMS when used in a Lonworks network, or the 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.

2.7.3.1.7 Dual Temperature Water

Plus or minus 2 degrees F.

2.7.3.1.8 Heating Hot Water

Plus or minus 2 degrees F.

2.7.3.1.9 Condenser Water

Plus or minus 2 degrees F.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 AFMA's 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 AFMA's 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 AFMA's 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 NOT USED

2.7.7.3 NOT USED

2.7.7.4 NOT USED

2.7.7.5 NOT USED

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 NOT USED

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 0.5 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.7.8.4 Energy Metering

2.7.8.4.1 Watt or Watthour Transducers

Watt transducers must measure voltage and current and must output kW or kWh or both kW and kWh as indicated. kW outputs must have an accuracy of plus or minus 0.5 percent over a power factor range of 0.1 to 1. kWh outputs must have an accuracy of plus or minus 0.5 percent over a power factor range of 0.1 to 1.

2.7.8.4.2 Watthour Revenue Meter (with and without Demand Register)

All Watthour revenue meters must measure voltage and current and must be in accordance with ANSI C12.1 with an ANSI C12.20 Accuracy class of 0.5 and must have pulse initiators for remote monitoring of Watthour consumption. Pulse initiators must consist of form C contacts with a current rating not to exceed two amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Meter sockets must be in accordance with NEMA/ANSI C12.10. Watthour revenue meters with demand registers must output instantaneous demand in addition to the pulse initiators.

2.7.8.4.3 Steam Meters

Steam meters must be the vortex type, with pressure compensation, a minimum turndown ratio of 10 to 1, and an output signal compatible with the DDC system.

2.7.8.4.4 Hydronic BTU Meters

The BTU meter is to be supplied with wall mount hardware and be capable of being installed remote from the flow meter. The BTU meter must include an LCD display for local indication of energy rate and for display of parameters and settings during configuration. Each BTU meter must be factory configured for its specific application and be completely field configurable by the user via a front panel keypad (no special interface device or computer required). The unit must output Energy Rate, Energy Total, Flow Rate, Supply Temperature, and Return Temperature. An integral transmitter is to provide a linear analog or configurable pulse output signal representing the energy rate; and the signal must be compatible with building automation system DDC Hardware to which the output is connected.

2.7.9 NOT USED

2.7.10 NOT USED

2.7.11 NOT USED

2.7.12 Occupancy Sensors

Occupancy sensors must have occupancy-sensing sensitivity adjustment and an adjustable off-delay timer with a setpoint of 15 minutes. Adjustments accessible from the face of the unit are preferred. Occupancy sensors must be rated for operation in ambient air temperatures ranging from 40 to 95 degrees F or temperatures normally encountered in the installed location. Sensors integral to wall mount on-off light switches must have an auto-off switch. Wall switch sensors must be decorator style and must

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

fit behind a standard decorator type wall plate. All occupancy sensors, power packs, and slave packs must be UL listed. In addition to any outputs required for lighting control, the occupancy sensor must provide an output for the HVAC control system.

2.7.12.1 Passive Infrared (PIR) Occupancy Sensors

PIR occupancy sensors must have a multi-level, multi-segmented viewing lens and a conical field of view with a viewing angle of 180 degrees and a detection of at least 20 feet unless otherwise indicated or specified. PIR Sensors must provide field-adjustable background light-level adjustment with an adjustment range suitable to the light level in the sensed area, room or space. PIR sensors must be immune to false triggering from RFI and EMI.

2.7.12.2 Ultrasonic Occupancy Sensors

Ultrasonic sensors must operate at a minimum frequency 32 kHz and must be designed to not interfere with hearing aids.

2.7.12.3 Dual-Technology Occupancy Sensor (PIR and Ultrasonic)

Dual-Technology Occupancy Sensors must meet the requirements of both PIR and Ultrasonic Occupancy Sensors.

2.7.13 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.7.14 NOT USED

2.7.15 NOT USED

2.7.16 NOT USED

2.7.17 NOT USED

2.7.18 NOT USED

2.7.19 NOT USED

2.7.20 Temperature Switch

2.7.20.1 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.

2.7.20.2 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.

2.7.21 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.

2.7.22 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

limit. Accuracy must be plus or minus two percent of scale range.

2.8.4 NOT USED

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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).

2.12 NOT USED

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 be 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, 60 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 5 feet above the finished floor. Non user-adjustable sensors can be mounted as indicated in paragraph ROOM INSTRUMENT MOUNTING.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 as indicated on the design documents. 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 may 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 its 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 NOT USED

3.1.14.2 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, except low-voltage control and low-voltage network wiring may be installed as follows:

- a. plenum rated cable in suspended ceilings over occupied spaces may be run without raceways
- b. nonmetallic-sheathed cables or metallic-armored cables may be installed as permitted by NFPA 70.

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

to apparatus. For connections to apparatus use brass compression type fittings.

3.1.17 Plastic Tubing

Install plastic tubing within covered raceways or conduit except when otherwise specified. Do not use plastic tubing for applications where the tubing could be subjected to a temperature exceeding 130 degrees F. For fittings, use brass or acetal resin of the compression or barbed push-on type for instrument service. Except in walls and exposed locations, plastic multitube instrument tubing bundle without conduit or raceway protection may be used where a number of air lines run to the same points, provided the multitube bundle is enclosed in a protective sheath, is run parallel to the building lines and is adequately supported as specified.

3.1.18 NOT USED

Run tubing concealed in finished areas, run tubing exposed in unfinished areas like mechanical rooms. For tubing enclosed in concrete, provide rigid metal conduit. Run tubing parallel and perpendicular to building walls. Use 5 foot maximum spacing between tubing supports. With the compressor turned off, test each tubing system pneumatically at 1.5 times the working pressure and prove it air tight, locating and correcting leaks as applicable. Caulking joints is not permitted. Do not run tubing and electrical power conductors in the same conduit.

- a. Install pneumatic lines must such that they are not exposed to outside air temperatures. Conceal pneumatic lines except in mechanical rooms and other areas where other tubing and piping is exposed.
- b. Install all tubes and tube bundles exposed to view in lines parallel to the lines of the building. Route tubing in mechanical/electrical so that the lines are easily traceable.
- c. Purge air lines of dirt, impurities and moisture before connecting to the control equipment. Number-code or color-code air lines and key the coding in the As-Built Drawings for future identification and servicing the control system.

3.1.19 NOT USED

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 09 23.02

BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS 08/24

PART 1 GENERAL

1.1 SUMMARY

Provide a complete Direct Digital Control (DDC) system, except for the front end which is specified in Section 25 10 10 UTILITY MONITORING AND CONTROL (UMCS) FRONT END AND INTEGRATION, 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.

Except for Gateways, the control system must be an open implementation of BACnet technology using ASHRAE 135 as the communications protocol. The system must use standard ASHRAE 135 Objects and Properties. The system must use standard ASHRAE 135 Services exclusively for communication over the network. Gateways to packaged units must communicate with other DDC hardware using ASHRAE 135 exclusively and may communicate with packaged equipment using other protocols. The control system must be installed such that any two 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 Objects as 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. Niagara Framework Supervisory Gateway must serve web pages as specified.
- d. Use Niagara Framework either AX or Version 4.0 or later.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 BV-CE 2022; Interpretation 9-12 2022; Interpretation 13-24 2023; Addenda BV-CF 2023; Errata 3 2023) BACnet—A Data Communication Protocol for Building Automation and Control Networks

BACNET TESTING LABORATORIES (BTL)

BTL Guide (v.50; 2022) BACnet Testing Laboratory Implementation Guidelines

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3 (2022; CORR 2024) 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 (2021) NiagaraAX User's Guide

Tridium Open NiCS (2021) Understanding the NiagaraAX Compatibility Statement (NiCS)

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15 Radio Frequency Devices (47 CFR 15)

UL SOLUTIONS (UL)

UL 916 (2015; Reprint Oct 2021) UL Standard for Safety Energy Management Equipment

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 of Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC, Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS 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.)

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.1.3 Ethernet Switch

Ethernet Switches must be as specified in Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- (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 mA_{dc} or 0-10 V_{dc}. 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 Scheduling Hardware

DDC Hardware used for scheduling must meet the following requirements:

- a. It must be BTL Listed as a B-BC and support the SCHED-E-B BIBB.
- b. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Calendar and Schedule Objects, such that a front end BTL listed as a B-AWS may create or delete Calendar and Schedule Objects. It is also preferred but not required that devices supporting the DM-OCD-B BIBB accept any valid value for properties of Calendar and Schedule Objects. Note that there are additional requirements in the EXECUTION Part of this Section for Devices which do not support the DM-OCD-B BIBB as specified.
- c. The Date_List property of all Calendar Objects must be writable.
- d. The Present_Value Property of Schedule must support the following values: 1, 2, 3, 4.

2.3.5.2 Alarm Generation Hardware

Non-Niagara Framework DDC Hardware used for alarm generation must meet the following requirements:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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.
- e. For Event Enrollment Objects used for alarm generation, the following Properties must be Writable:
 - (1) Event_Parameters
 - (2) Event_Enable
 - (3) If the issue date of this project specification is after 1 January 2016, Time_Delay_Normal must be writable.
- f. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Notification Class Objects and Event Enrollment Objects, such that a front end BTL listed as a B-AWS may create or delete Notification Class Objects and Event Enrollment 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 and Event Enrollment Objects. Note that there are additional requirements in the EXECUTION Part of this Section for devices which do not support the DM-OCD-B BIBB as specified.
- g. Devices provided to meet the the requirements indicated under "Support for Future Alarm Generation" in the EXECUTION part of this specification must support the AE-N-E-B BIBB.

2.3.5.3 Trending Hardware

DDC Hardware used for collecting trend data must meet the following requirements:

- a. Device must support Trend Log or Trend Log Multiple Objects.
- b. Device must support the T-VMT-I-B BIBB.
- c. Devices provided to meet the EXECUTION requirement for support of Future Trending must support the T-VMT-E-B BIBB.
- d. The following properties of all Trend Log or Trend Log Multiple Objects must be present and Writable:
 - Start_Time
 - Stop_Time

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Log_DeviceObjectProperty

Log Interval Log interval must support an interval of at least 60 minutes duration.

- e. Trend Log Objects must support using Intrinsic Reporting to send a BUFFER_FULL event.
- f. The device must have a Notification Class Object for the BUFFER_FULL event. The Recipient_List Property must be Writable.
- g. Devices must support values of at least 1,000 for Buffer_Size Properties.
- h. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Trend Log Objects, such that a front end BTL listed as a A-AWS may create or delete Trend Log 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 Trend Log Objects. Note that there are additional EXECUTION requirements for devices which do not support the DM-OCD-B BIBB as specified.

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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.

Monitoring and Control Software is specified in Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION.

PART 3 EXECUTION

3.1 CONTROL SYSTEM INSTALLATION 3.1.1 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 as indicated. 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 2020 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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. Coordinate Device IDs and Network Numbers with the installation. The installation POC is Joe Dye.
- b. Coordinate device IP addresses with installation. The installation POC is Joe Dye.

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,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

notify Joe Dye 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 external 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

correspondence between value and occupancy mode specified in paragraph OCCUPANCY MODES.

- f. Use Schedule Objects and Calendar Objects for all scheduling. Use Trend Log Objects or Trend Log Multiple Objects for all trending and Notification Class Objects for trend log upload. Use a combination of Event Enrollment Objects, Intrinsic Alarming, and Notification Class Objects for alarm generation.
- g. Use a combination of Niagara Framework Alarm Extensions and Alarm Services, Intrinsic Alarming, and Notification Class Objects for alarm generation.
- h. 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 using the project site sample displays, including overrides, as indicated on the Points Schedule and as specified. Label all points on displays with full English language descriptions. 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 BACnet Scheduling Objects to schedule systems as indicated on the Points Schedule and as specified using the indicated correspondence between value and occupancy mode. If no devices supports both the SCHED-E-B and DM-OCD-B BIBBS for Schedule Objects, provide 5 blank Schedule Objects in DDC Hardware BTL listed as B-BCs and supporting the SCHED-E-B BIBB for later use by the site. 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) or group of stand-alone Terminal Units acting according to a common schedule as indicated.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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. Use of alarm generation types:
 - (1) Only use algorithmic alarm generation when intrinsic alarm generation is not supported by the device or object, or when the specific alarm conditions cannot be implemented using intrinsic alarm generation.
 - (2) Only use remote alarm generation when the alarm cannot be generated using intrinsic or local algorithmic alarm generation on the device containing the referenced property. If remote alarm generation is used, use the same DDC Hardware for all remote alarm generation within a single sequence.
- h. 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 Support for Future Alarm Generation

For every piece of DDC Hardware, support future alarm generation capabilities by supporting either intrinsic or additional algorithmic alarming. Provide one of the following:

- a. Support intrinsic alarming for every Object used by the application in that device.
- b. Support additional Event_Enrollment Objects. For DDC hardware controlling a single terminal unit, support at least one additional object. Otherwise, support at least 4 additional Objects. Support additional Event_Enrollment Objects via one of the following:
 - (1) Provide unused Event_Enrollment Objects on that device.
 - (2) Support the DM-OCD-B BIBB and the creation of sufficient Event_Enrollment Objects on that device.
 - (3) Provide one or more devices in the IP network that support the AE-N-E-B BIBB and have unused Event_Enrollment Objects.
 - (4) Provide one or more devices on the IP network that support the AE-N-E-B BIBB, the DM-OCD-B BIBB, and the creation of sufficient Event_Enrollment Objects.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

The total number of Event_Enrollment Objects required by the project is the sum of the individual device requirements, and the distribution of Event_Enrollment Objects among devices is not further restricted. (Note this allows a single device to contain many Event_Enrollment Objects satisfying the requirements for multiple devices.)

3.1.4.5 Trend Log Configuration

- a. Configure trends in Trend Log or Trend Log Multiple Objects as indicated on the Points Schedule and as specified.
- b. Configure all trend logs (including any provided to support future trends) to save data on regular intervals using the BUFFER_FULL event to request trend upload from the front end.
- c. Configure Trend Log Objects with a minimum Buffer_Size property value of 1,000 and Trend Log Multiple Objects with a minimum Buffer_Size property value of 1,000 per point trended (for example, a Trend Log Multiple Object used to trend 3 points must have a Buffer_Size Property value of at least 3,000).
- d. Configure a Notification Class Object in devices doing trending (including devices supporting future trends) to handle the BUFFER_FULL event.
- e. When possible, trend each point using an Object in the device containing the point. When it is necessary to trend using a an Object in another device, all trends not on the same Device as the Object being trended must be on a single device (i.e. all Trend Log and Trend Log Multiple Objects used for remote trending within a sequence must be on the same device).
- f. For each trend log, including any trend logs provided to support future trending, configure the following properties as specified:
 - (1) Logging_Type: Set to Polling
 - (2) Stop_When_Full: Set to Wrap Around
 - (3) Buffer_Size: Set to 400 or greater.
 - (4) Notification_Threshold: Set to 90 percent of full
 - (5) Notification_Class: Set to the Notification Class Object in that device
 - (6) Event_Enable: Set to TRUE
 - (7) Log_Interval: Set to 15 minutes.
- g. Future Trending support. Provide support for future trending:
 - (1) Provide one or more devices on the Building Control Network Backbone IP network which support both the T-VMT-E-B and DM-OCD-B BIBBs for Trend Log Objects. Provide sufficient devices to support the creation of at least one additional Trend Log Object for every terminal unit plus 4 additional Trend Log Objects for every non-terminal unit.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- (2) Provide one additional Trend Log Object for every terminal unit plus 4 additional Trend Log Objects for every non-terminal unit in one or more devices on the Building Control Network Backbone IP network that support the T-VMT-E-B BIBB for later use by the site.
- (3) A combination of these two methods is permitted provided the total required number of Trend Log Objects is met.

3.1.4.6 Trending

Perform all trending using a Niagara Framework Supervisory Gateway using Niagara Framework History Extensions and Niagara Framework History Service exclusively.

3.1.4.7 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 09 53.00 20

SPACE TEMPERATURE CONTROL SYSTEMS

02/10, CHG 3: 08/24

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 500-D (2018) Laboratory Methods of Testing
Dampers for Rating

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

ASHRAE FUN IP (2021) Fundamentals Handbook, I-P Edition

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1 (2020) Gray Iron Pipe Flanges and Flanged
Fittings Classes 25, 125, and 250

ASME B16.5 (2020) Pipe Flanges and Flanged Fittings
NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B16.34 (2021) Valves - Flanged, Threaded and
Welding End

ASME B31.1 (2024) Power Piping

ASME B31.5 (2022) Refrigeration Piping and Heat
Transfer Components

ASME B40.100 (2022) Pressure Gauges and Gauge
Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A126 (2004; R 2023) Standard Specification for
Gray Iron Castings for Valves, Flanges,
and Pipe Fittings

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

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

NEMA ST 1 (1988; R 1994; R 1997) Specialty
Transformers (Except General Purpose Type)

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 1 2024; TIA 24-1) National Electrical Code
NFPA 90A	(2024) Standard for the Installation of Air Conditioning and Ventilating Systems

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

SMACNA 1780	(2023) HVAC Systems - Testing, Adjusting and Balancing, 4th Edition
SMACNA 1966	(2020) HVAC Duct Construction Standards Metal and Flexible, 4th Edition

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	Radio Frequency Devices (47 CFR 15)
-------------	-------------------------------------

UL SOLUTIONS (UL)

UL 508	(2018; Reprint Jul 2021) UL Standard for Safety Industrial Control Equipment
UL 916	(2015; Reprint Oct 2021) UL Standard for Safety Energy Management Equipment

1.2 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph SUBCONTRACTOR SPECIAL REQUIREMENTS in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS. The paragraph specifies that all contract requirements of this section shall be accomplished directly by a first tier subcontractor. No work required shall be accomplished by a second tier subcontractor.

1.3 SYSTEM DESCRIPTION

Provide new and modify existing space temperature control systems complete and ready for operation.

1.4 SYSTEM REQUIREMENTS

Provide control systems composed of any combination of electric, electronic, or analog devices. Indicated control system devices of a particular type do not intend a requirement for the device unless the requirement is specifically indicated. Requirements apply to field installed control systems.

Inspect and test reused portions of existing control systems, and furnish a report to the Government identifying all inoperative components or system deficiencies. The report shall include a cost estimate to correct deficiencies, scheduled need dates for equipment shutdown for repairs and connection to existing controls and systems. Proceed with repairs only after receipt of Government approval. Diagnose and report any malfunctions of existing control system device that occurs after the work

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

commences. The Government is responsible for maintenance and repair of Government equipment. The Contractor shall be held responsible for repair costs due to Contractor negligence or abuse of Government equipment.

1.5 CENTRALIZED DIRECT DIGITAL CONTROL (DDC) SYSTEMS

DDC systems are not permitted. Microprocessor-based single-loop controllers, unitary control system, variable-air-volume (VAV) boxes, and room thermostats may be used provided that the devices are manually configurable by the use of device firmware and require no software written by the Contractor for their application and use.

1.6 PERFORMANCE REQUIREMENTS

Provide control systems to maintain the required heating, ventilating, and cooling (HVAC) conditions by performing the functions and sequences of operations indicated. Control systems shall be complete, including all equipment and appurtenances, and ready for operation. Control systems shall be furnished, installed, tested, calibrated, and started up by, or under the supervision of trained technicians certified by the Contractor as qualified and regularly employed in such work. Control system equipment, valves, panels and dampers shall bear the manufacturer's nameplate.

1.7 DESIGN REQUIREMENTS

1.7.1 Control System Diagrams

For each system, indicate HVAC process flow and location of devices relative to flow and to the HVAC control panel, the connections of control devices in control loops, references of control device contacts and device operating coils to line numbers of a ladder diagram and sequencing diagrams showing the operation of valves, dampers, and contacts relative to controller output, and HVAC process variables.

1.7.2 Ladder Diagram

Indicate connections and interlocks to control system devices and other devices such as starters, drives, HVAC control system panels, and HVAC equipment panels. Coordinate diagram by line number and device number with each control system diagram.

1.7.3 Operating Parameters

Indicate operating parameters for devices shown on the control system diagram such as setpoints, ranges, limits, differentials, outside air temperature schedules, contact operating points, and HVAC equipment operating time schedules.

1.7.4 Automatic Control Valve Schedules

Indicate valve size, Cv, flow rate, pressure drop, top size, spring range, positioner range, operating signal characteristics, and power source.

1.7.5 Damper Schedules

Indicate damper sizes, quantities and sizes of actuators, spring ranges, positioner ranges, operating signal characteristics, and power source.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.7.6 Wiring Diagram

Indicate terminal blocks, wire marker identification, connections to control system devices, external and internal power sources, and connections to external devices, starters, drives, control panels, jumpers, and ground connections.

1.7.7 Sequence of Operation

Sequence of operation for each HVAC control system coordinated with device identifiers on control system diagram and ladder diagram.

1.7.8 Arrangement Drawing

Arrangement diagram of each HVAC control system panel coordinated with device identifiers on the control system diagram and the ladder diagram.

1.8 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are 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

Control System Diagrams for each HVAC system; G,
Ladder Diagram; G,
Operating Parameters; G,
Automatic Control Valve Schedules; G,
Damper Schedules; G,
Sequence of Operation; G,
Arrangement Drawing; G,
Wiring Diagram; G,

SD-03 Product Data

Actuators; G,
Valves; G,
Dampers; G,
Fire Protection Devices; G,
Sensors; G,
Thermostats; G,
Sunshields; G,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Pressure Switches; G,
Indicating Devices; G,
Controllers; G,
Pressure Gages; G,
Control Panels; G,
VAV Terminal Unit Controls; G,

SD-06 Test Reports

Commissioning Procedures; G,
Calibration Adjustment And Commissioning Reports; G,
Site Testing Procedures Identifying Each Item Tested and
Describing Each Test; G,
Performance Verification Test plans and procedures; G,

SD-07 Certificates

Certification of Completion; G,

SD-08 Manufacturer's Instructions

Training Course Documentation; G,

SD-10 Operation and Maintenance Data

Space Temperature Control System, Data Package 3; G,
Submit in accordance with Section 01 78 23 OPERATION AND
MAINTENANCE DATA.

SD-11 Closeout Submittals

Qualified Service Organization List; G,

1.9 QUALITY ASSURANCE

1.9.1 Cybersecurity

Coordinate submittals with Section 25 05 11 CYBERSECURITY FOR
FACILITY-RELATED CONTROL SYSTEMS.

1.9.2 Standard Products

- a. Material and equipment shall be standard products of manufacturers regularly engaged in the manufacturing of such products, using similar materials, design and workmanship. The 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 similarly sized equipment and materials used under similar circumstances.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- b. 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, manufacturers' 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.
- c. The equipment items shall be supported by a service organization.

1.9.3 Nameplates and Tags

- a. Provide nameplates bearing legends as shown and tags bearing device unique identifiers as shown shall have engraved or stamped characters. Nameplates shall be mechanically attached to HVAC control panel doors.
- b. A plastic or metal tag shall be mechanically attached directly to each field-mounted device or attached by a metal chain or wire.
- c. Each airflow measurement station shall have a tag showing flow rate range for signal output range, duct size, and device identifier where shown.

1.9.4 Verification of Dimensions

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

1.9.5 Modification of References

Accomplish work in accordance with ASME B31.1, ASME B31.5, NFPA 70, and NFPA 90A, except as modified herein or indicated otherwise for equipment, materials, installation, examination, inspection, and testing. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had be substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "authority having jurisdiction" and "owner" to mean the Contracting Officer.

1.9.6 Site Testing Procedures

Indicate test equipment to be used including manufacturers' names and model numbers, date of last calibration, and accuracy of calibration.

1.9.7 Commissioning Procedures

Define procedures specific to each control system including instructions on how to set control parameters and setpoints, proportional, integral and derivative mode constants, contact output settings, positioner range adjustments, and calibration checks of transmitters

1.9.8 Calibration Adjustment and Commissioning Reports

Submit specific to each HVAC control system, including settings adjustments and results of calibration checks

1.9.9 Space Temperature Control System

In addition to the requirements specified in the paragraph SUBMITTALS,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

meet the following requirements. Submit Operation and Maintenance Manuals for items of equipment listed under paragraph PRODUCT DATA. Manual shall contain full hardware support documentation, which shall include but not be limited to the following:

- a. General description and specifications
- b. Installation and initial checkout procedures
- c. Detailed electrical and logical description
- d. Troubleshooting procedures, diagrams, and guidelines
- e. Alignment and calibration procedures for components
- f. Preventive maintenance requirements and a maintenance checklist
- g. Detailed schematics and assembly drawings
- h. Spare parts list data, including required tool kits and suggested method of repairs such as field repair, factory repair, or item replacement
- i. Signal identification and timing diagrams
- j. Complete as-built control drawings, schedules, and sequence of operation
- k. Controller configuration and parameter setting procedures
- l. Step-by-step procedures required for each HVAC control systems startup, operation, shutdown, recovery, and fault diagnosis
- m. Manufacturer supplied operator manuals for equipment
- n. Qualified service organization list

PART 2 PRODUCTS

2.1 COMPONENTS

Provide components factory ordered for this project. Rebuilt equipment, warehoused equipment, or earlier generation equipment shall not be acceptable. Electrical, electronic, and electropneumatic devices not located within control panels shall have a NEMA 250 Type 1 enclosure in accordance with NEMA 250 unless otherwise specified. Actuators and positive positioners, and transmitters shall operate within temperature limit ratings of plus 35 to 150 degrees F. Panel mounted instruments shall operate within limit ratings of 35 to 120 degrees F and 10 percent to 95 percent relative humidity, noncondensing. Devices installed outdoors shall operate within limit ratings of minus 35 to 150 degrees F.

2.2 ACTUATORS

Provide electric, or electronic actuators. Actuators shall function as required within 85 to 110 percent of their power supply rating. Actuators shall fail to their spring return positions on signal or power failure unless indicated as timed, power return actuators. Actuators shall have visible position indicators. Where actuators do not have positive spring

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

returns for fail-safe operation, provide restrictors, and relays, or reserve power as required to achieve proper timed positioning for up to 4 minutes after primary power failure. Actuators shall open or close the devices to which they are applied within 60 seconds after a full scale signal input change. Pneumatic actuators shall be rated for 25 psig operating pressure except for high pressure cylinder type actuators.

2.2.1 Damper Actuators

Damper actuators shall be rated for at least 125 percent of the motive power necessary to operate the connected damper. The actuator stroke shall be limited by an adjustable stop in the direction of the return stroke. Actuators shall be provided with mounting and connecting hardware.

2.2.2 Valve Actuators

Valve actuators shall be rated for at least 125 percent of the motive power necessary to operate the valves over their full range of operation against the total and differential pressures.

2.3 AUTOMATIC CONTROL VALVES

Provide automatic control valves.

2.3.1 Valve Assembly

Valves shall have stainless steel stems and stuffing boxes with extended necks to clear the piping insulation. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Maximum rated shutoff pressure of the valve shall exceed the rated deadhead pressure of the pump that supplies it. Valve leakage rating shall be 0.01 percent of rated Cv for soft-seated valves and 0.05 percent for metal-to-metal seated valves. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall conform to ASME B16.5 as a minimum. Components of cast iron valves shall conform to ASTM A126 Class B or C as a minimum.

2.3.2 Butterfly Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service, and for modulation to the fully closed position, with carbon steel bodies or cast iron Class 125 and noncorrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from minus 20 degrees to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator.

2.3.3 Two-Way Valves

Two-way modulating valves shall have equal percentage characteristics.

2.3.4 Three-Way Valves

Three-way valves shall provide constant total flow throughout full plug travel.

2.3.5 Duct-Coil and Terminal-Unit-Coil Valves

Control valves with either flare-type or solder-type ends shall be provided for duct or terminal-unit coils. Flare nuts shall be provided

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

for each flare-type end valve.

2.3.6 Valves for Chilled Water, Condenser Water, and Glycol Service

ASME B16.1. Bodies for valves 2 inches and smaller shall be brass or bronze, with threaded-end or union-end connections. Bodies for valves from 2.5 inches and larger shall be cast iron. Bodies for valves 2.5 inches and larger shall have flanged-end connections. Internal valve trim shall be brass or bronze except that valve stems may be Type 316 stainless steel. Water valves shall be sized for a 3 psi differential through the valve at rated flow, except as indicated otherwise. Select valve flow coefficient (Cv) for an actual pressure drop not less than 50 percent or greater than 125 percent of the design pressure drop at design flow. Valves 4 inches and larger shall be butterfly valves.

2.3.7 Valves for Hot Water Service

Valves for hot water service below 250 Degrees F shall conform to ASME B16.1. Bodies for valves 2 inches and smaller shall be brass or bronze, with threaded-end or union-end connections. Bodies for valves 2.5 inches and larger shall be cast iron. Bodies for 2.5 inches and larger shall have flanged-end connections. Water valves shall be sized for a 3 psi differential through the valve at rated flow, except as indicated otherwise. Select valve flow coefficient (Cv) for an actual pressure drop not less than 50 percent or greater than 125 percent of the design pressure drop at design flow. Internal trim, including seats, seat rings, modulating plugs, and springs, of valves controlling water hotter than 210 degrees F shall be Type 316 stainless steel. Internal trim for valves controlling water 210 degrees F or less shall be brass or bronze. Non-metallic parts of hot water control valves shall be suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher. Valves 4 inches and larger shall be butterfly valves.

2.3.8 Valves for Steam Service

ASME B16.1. Bodies for valves 1.5 inches and smaller shall be brass or bronze, with threaded or union ends. Bodies for valves 2 to 3 inches inclusive shall be brass, bronze, or cast iron. Bodies for valves 4 inches and larger shall be cast iron. Bodies for 2 inch valves shall have threaded ends. Bodies for valves 2.5 inches and larger shall be provided with flanged-end connections. Internal valve trim shall be Type 316 stainless steel. Steam valves shall be sized for 15 psig inlet steam pressure with a maximum 13 psi differential through the valve at rated flow, except as indicated otherwise.

2.3.9 Valves for High Temperature Hot Water Service

Valves for high temperature hot water service above 250 degrees F. Valve bodies shall conform to ASME B16.34 Class 300. Valve and actuator combination shall be normally closed. Bodies shall be carbon steel, globe type with welded ends on valves one inch and larger. Valves smaller than one inch shall have socket-weld ends. Packing shall be virgin polytetrafluoroethylene (PTFE). Internal valve trim shall be Type 316 stainless steel. Water valves shall be sized for a 3 psi differential pressure through the valve at rated flow, except as indicated otherwise. Select valve flow coefficient (Cv) for an actual pressure drop not less than 50 percent or greater than 125 percent of the design pressure drop at design flow.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.4 DAMPERS

Provide dampers in air ducts.

2.4.1 Damper Assembly

Damper shall conform to SMACNA 1966. A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall consist of a combination of sections. Dampers shall be steel or other materials where indicated. Flat blades shall be made rigid by folding the edges. Provide blades with compressible seals at points of contact. Provide channel frames of dampers with jamb seals to minimize air leakage. Dampers shall not leak in excess of 10 cfm per square foot at 4 inches water gage static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 degrees F to 200 degrees F. Dampers shall be rated at not less than 2000 fpm air velocity. Moving parts of the operating linkage in contact with each other shall consist of dissimilar materials. Damper axles shall be 0.5 inch minimum plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by a non-ferrous dissimilar thrust bearings. Pressure drop through dampers shall not exceed 0.05 inch water gage at 1,000 fpm in the wide-open position. Frames shall not be less than 2 inches wide. Dampers shall be tested in accordance with AMCA 500-D.

2.4.2 Operating Links

Operating links external to dampers, such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Mating parts shall consist of dissimilar materials. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed position of dampers.

2.5 FIRE PROTECTION DEVICES

Provide smoke detectors in return and supply air ducts on the downstream side of the filters in accordance with NFPA 90A, except as otherwise indicated. Provide UL listed or FM approved detectors for duct installation.

2.5.1 Smoke Detectors

Provide in each air-handling system with supply air capacity greater than 2000 cfm in accordance with NFPA 90A. Locate downstream of the supply air filters and prior to any branch connection in accordance with NFPA 72. Provide in each air-handling system, serving more than one story, and having a return air capacity greater than 15000 cfm in accordance with NFPA 90A. Locate at each story prior to connection to common return and at return connection to air handler prior to any fresh air inlet connection and prior to any recirculation connection in accordance with NFPA 72. Smoke control and exhaust systems shall have provision for automatic and manual operation by means of a key-operated switch to override any other shutdown features and shall be located adjacent to the fire alarm system control panel.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Provide in each air-handling system with supply air capacity greater than 2000 cfm in accordance with NFPA 90A. Locate downstream of the supply air filters and prior to any branch connection in accordance with NFPA 72.

Provide in each air-handling system, serving more than one story, and having a return air capacity greater than 15000 cfm in accordance with NFPA 90A. Locate at each story prior to connection to common return and at return connection to air handler prior to any fresh air inlet connection and prior to any recirculation connection in accordance with NFPA 72. Design for detection of abnormal smoke densities by the photoelectric principle, responsive to both invisible and visible particles of combustion, and not susceptible to undesired operation by changes to relative humidity.

Provide UL listed or FM approved detectors for duct installation. Provide duct detectors with an approved duct housing, mounted exterior to the duct, and with perforated sampling tubes extending across the width of the duct. Provide permanent descriptive zone labels indicating in which air-handling units the detectors in alarm are located.

Provide detectors with a test port, test switch . Provide control and power modules required for operation of detectors in their own control unit or integral with the main building fire alarm control panel. A ground fault or single break or open condition in electrical circuitry to any detector or its control or power units shall cause activation of building fire alarm control panel trouble signals.

Electrical supervision of wiring used exclusively for air-handling unit shutdown is not required provided a break in wiring would cause shutdown of the associated unit. Equipment and devices shall be compatible and operable in all respects with, and shall in no way impair reliability or operational functions of, the existing building fire alarm system. The existing fire alarm control panel was manufactured by Simplex.

Smoke control and exhaust systems shall have provisions for manual operation by means of a key-operated switch to override any other shutdown features and shall be located adjacent to the fire alarm system control panel.

Provide in each air-handling system with supply air capacity greater than 2000 cfm in accordance with NFPA 90A. Locate downstream of the supply air filters and prior to any branch connection in accordance with NFPA 72. Provide in each air-handling system, serving more than one story, and having a return air capacity greater than 15000 cfm in accordance with NFPA 90A. Locate at each story prior to connection to common return and at return connection to air handler prior to any fresh air inlet connection and prior to any recirculation connection in accordance with NFPA 72.

Design for detection of abnormal smoke densities by the ionization or photoelectric principle, responsive to both invisible and visible particles of combustion, and not susceptible to undesired operation by changes in relative humidity. Provide UL listed or FM approved detectors for duct installation. Provide duct detectors with an approved duct housing, mounted exterior to the duct, and with perforated sampling tubes extending across the width of the duct.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Provide 115 Vac power supply unit integral with duct housing. Obtain power from the source to the air-handling unit or air-handling unit controls. Detectors shall have test port or test switch. Provide remote alarm indicator and keyed test device at the location indicated. Provide each detector with a visible indicator lamp that lights when the detector is activated.

Activation of duct detector shall cause shutdown of the associated air-handling unit and closing of dampers and shall sound an alarm bell, with minimum 6 inch diameter, in a normally occupied area located as directed.

2.6 SENSORS

2.6.1 Spans and Ranges

Transmitters shall be calibrated to provide an electric or electronic output signal of 4 to 20 mA electric or electronic over the indicated span or range.

- a. Conditioned space temperature, from 50 to 100 degrees F.
- b. Duct temperature, from 40 to 140 degrees F.
- c. Chilled water temperature, from 30 to 80 degrees F.
- d. Heating hot water temperature, from 100 to 250 degrees F.
- e. Outside air temperature, from minus 30 to 130 degrees F.
- f. Differential pressure for VAV supply duct static pressure from 0 to 2.0 inches water gage.

2.6.2 Temperature Sensors

2.6.2.1 Resistance Temperature Detectors (RTD's)

RTD shall be platinum with a tolerance of plus or minus 0.25 percent at 32 degrees F, and shall be encapsulated in epoxy, Series 300 stainless steel, anodized aluminum, or copper. RTD shall be furnished with RTD transmitter as specified, integrally-mounted unless otherwise indicated.

2.6.2.2 Continuous Averaging RTD's

Continuous averaging RTD's shall have a tolerance of plus or minus 1.0 degrees F at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross section in which it is installed. Sensing element shall have a bendable copper sheath. Averaging RTD shall be furnished with RTD transmitter as specified, to match the resistance range of the averaging RTD. Element length shall be a minimum of one linear foot per square foot of coil face area.

2.6.2.3 RTD Transmitter

RTD transmitter shall be selected to match the resistance range of the RTD. Transmitter shall be a two-wire, loop-powered device. Transmitter shall produce a linear 4 to 20 mA dc output corresponding to required

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

temperature measurement. Output error shall not exceed 0.1 percent of the calibrated measurement. Transmitter shall include offset and span adjustments.

2.6.3 Relative Humidity Instruments

2.6.3.1 Relative Humidity Sensor

Provide relative humidity sensor. Use nonsaturating sensing elements capable of withstanding a saturated condition without permanently affecting calibration or sustaining damage. Sensing elements shall be bulk polymer or thin film polymer. Sensing elements shall have an accuracy of plus or minus 2 percent of full scale within the range of 20 to 80 percent relative humidity. Provide a two-wire, loop-powered transmitter located at the sensing elements to convert the sensing elements output to a linear 4 to 20 mA dc output corresponding to required humidity measurement. Output error shall not exceed 0.1 percent of calibrated measurement. Transmitter shall include offset and span adjustments. Transmitter shall have ability to be calibrated electronically by using a one-point, in-situ method which allows for error correction with a single potentiometer.

2.6.4 Dew Point Instruments

Provide analog salt-phase transition or dual chilled, mirror type sensor. Sensor shall have an allowable deviation of plus or minus one degrees F dew point over the range of 10 to 80 degrees F dew point.

2.6.5 Airflow Sensors

Provide airflow sensors.

2.6.5.1 Electronic Airflow Measurement Stations and Transmitters

- a. Stations shall contain an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. Velocity sensing elements shall be RTD or thermistor type, with linearizing means. Sensing elements shall be distributed across the duct cross section in the quantity and pattern set forth for measurements and instruments in accordance with ASHRAE FUN IP and SMACNA 1780, for traversing of ducted airflows. Resistance to airflow through the airflow measurement station shall not exceed 0.08 inch water gage at airflow of 2000 fpm. Station construction shall be suitable for operation at airflows of up to 5000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus 3 percent over a range of 125 to 2500 fpm scaled to air volume. Use stations if required velocity measurement is below 500 feet per minute.
- b. Transmitters shall produce a linear, temperature compensated 4 to 20 mA dc output corresponding to required velocity pressure measurement. Transmitters shall be a two-wire, loop-powered device. Output error of transmitters shall not exceed 0.5 percent of calibrated measurement. Transmitters shall have offset and span adjustments.

2.6.5.2 Pitot Tube Airflow Measurement Stations and Transmitters

- a. Stations shall contain an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. Velocity sensing elements shall be multiple pitot tube type with averaging

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

manifolds. Sensing elements shall be distributed across the duct cross section in the quantity and pattern set forth for measurements and instruments in accordance with ASHRAE FUN IP or SMACNA 1780, for traversing of ducted airflows. Resistance to airflow through the airflow measurement station shall not exceed 0.08 inch water gage at airflow of 2000 fpm. Station construction shall be suitable for operation at airflows of up to 5000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus 3 percent over a range of 500 to 2500 fpm scaled to air volume. Do not use stations if required velocity measurement is below 500 feet per minute.

- b. Transmitters shall produce a linear 4 to 20 mA dc output corresponding to the required velocity pressure measurement. Each transmitter shall have a low-range differential pressure sensing element and a square root extractor. The transmitter shall be a two-wire, loop powered device. Sensing element accuracy shall be plus or minus 1 percent of full scale, and overall transmitter accuracy shall be plus or minus 0.25 percent of the calibrated measurement. Each transmitter shall have offset and span adjustments.

2.6.6 Pressure Sensors

Provide electronic pressure sensor and transmitter. Sensor shall be a pressure transmitter with an integral sensing element. Sensor over pressure rating shall be 25 psig above its normal operating range. Sensing element accuracy shall be plus or minus one percent of full scale. Transmitter accuracy shall be plus or minus 0.1 percent of the calibrated measurement. Transmitter shall be a two-wire, loop-powered device. Transmitter shall produce a linear 4 to 20 mA dc output corresponding to required pressure measurement. Transmitter shall have offset and span adjustments.

2.7 THERMOWELLS

Provide brass or Series 300 stainless steel thermowells with threaded brass plug and chain, 2 inch lagging neck and extension type well, and inside diameter and insertion length as required for the application. Provide thermowells for immersion sensors with conducting material inside the well.

2.8 THERMOSTATS

Provide thermostats.

2.8.1 Ranges

Thermostat ranges shall be selected so that the setpoint is adjustable without tools between plus or minus 10 degrees F of the setpoint indicated.

2.8.2 Nonmodulating Electric Room Thermostats

Contacts shall be single-pole double-throw (SPDT), hermetically sealed, and wired to identified terminals. Maximum differential shall be 2 degrees F. Thermostat covers shall consist of locking metal or heavy-duty plastic, and shall be capable of being locked by an Allen wrench or special tool. Thermostats shall have manual switches as required by the application and a minimum range of 55 to 90 degrees F.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.8.3 Microprocessor-Based Room Thermostats

Microprocessor-based room thermostats shall have built-in keypads for scheduling of day and night temperature settings. Access to the scheduling mode shall be by password control code. When out of the scheduling mode, thermostats shall have continuous 12-hour time display, with AM and PM indication, continuous display of day of the week, and either continuous display of room temperature with display of temperature setpoint on demand, or continuous display of temperature setpoint with display of room temperature on demand. In the programmable mode, use the display for setting and interrogating time program ON-OFF setpoints for each day of the week. The time program shall allow two separate temperature setback intervals per day. Thermostats shall have a means for temporary and manual override of program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain timing and to maintain the schedule in memory for one year in the event of a power outage. Maximum differential shall be 2 degrees F. Where used for heat pump applications, thermostat shall have an emergency heat switch.

2.8.4 Nonmodulating Capillary Thermostats and Aquastats

- a. Thermostat shall have a capillary length of at least 5 feet, adjustable direct reading scales for both setpoint and differential, and a differential adjustable from 6 to 16 degrees F.
- b. Aquastats shall be strap-on type, with 10 degrees F fixed differential.

2.8.5 Low-Temperature Protection Thermostats (Freezestats)

Low-temperature protection thermostats shall be manually reset low-temperature safety thermostats, with NO and NC contacts or a two-position pneumatic output signal and a 20 foot element which shall respond to the coldest 18 inch segment.

2.8.6 Modulating Capillary Thermostats

Thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Thermostats shall have adjustable throttling ranges of 4 to 8 degrees F for each output.

2.9 SUNSHIELDS

Provide sunshields for outside air temperature sensing elements to prevent the sun from directly striking temperature sensing elements. Provide sunshields with adequate ventilation so that the sensing element responds to the ambient temperature of surroundings. The top of each sunshield shall have galvanized metal or aluminum rainshield projecting over the face of the sunshield. Sunshields shall be painted white or shall be unpainted aluminum.

2.10 PRESSURE SWITCHES AND SOLENOID VALVES

Provide pressure switches and solenoid valves.

2.10.1 Pressure Switches

Switches shall have an adjustable setpoint with visible setpoint scale.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Range shall be as indicated. Differential adjustment shall span 20 to 40 percent of the range of the device.

2.10.2 Differential Pressure Switches

Switches shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. Fittings shall be angled-tip type with tips pointing into the airstream. Range shall be 0.5 to 6 inches water gage. Differential shall be a maximum of 0.15 inch water gage at the low end of the range and 0.35 inch water gage at the high end of the range.

2.11 INDICATING DEVICES

Provide indicating devices.

2.11.1 Thermometers

- a. Thermometers for insertion in ductwork and piping systems shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, and permanently stabilized glass tube with an indicating fluid column, white face, black numbers, and a 9 inch scale.
- b. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern.
- c. Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid stem thermometers, the space between bulb and stem shall be filled with a heat transfer medium.
- d. Air duct thermometers shall have perforated stem guards and 45 degree adjustable duct flanges with locking mechanisms.
- e. Averaging thermometers shall have 3.5 inch (nominal) dial, with black legend on white background, and pointer traveling through a 270 degree arc.
- f. Thermometers shall have an accuracy of plus or minus one percent of scale range. Thermometers shall have the following ranges:
 - (1) Mixed air temperature: 0 to 100 degrees F in 1 degree F graduations.
 - (2) Return air temperature: 0 to 100 degrees F in 1 degree F graduations.
 - (3) Cooling coil discharge temperature: 0 to 100 degrees F in 1 degree F graduations.
 - (4) Heating coil discharge temperature: 30 to 180 degrees F in 2 degree F graduations.
 - (5) Hydronic heating systems below 220 degrees F: 40 to 240 degrees F in 2 degree graduations.
 - (6) Chilled water temperature: 0 to 100 degrees F in one degree F graduations.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- (7) Condenser water temperature: 40 to 140 degrees in one degree F graduations.
- (8) Glycol temperature: 0 to 100 degrees F for cooling service in one degree F graduations, and 40 to 240 degrees F for heating service in 2 degree F graduations.
- (9) High temperature hot water: 100 to 550 degrees F in 5 degree F graduations.

2.11.2 Pressure Gages

Provide pressure gages with gage cock, snubber, and syphon.

- a. ASME B40.100. Gages shall be 2 1/2 inch (nominal) size, back-connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270 degree arc. Accuracy shall be plus or minus 3 percent of scale range.
- b. Gages for indicating signal output to pneumatic actuators and main air gages shall have scale of 0 to 30 psig in 1 psig graduations.
- c. Gages for air storage tanks and for use before and after dirt and oil filters or dryers, shall have a scale of 0 to 160 psig with 2 psig graduations.
- d. Gages for hydronic system applications shall have ranges and graduations as indicated.

2.12 LOW-DIFFERENTIAL PRESSURE GAGES

Gages for low-differential pressure measurements shall be 4 1/2 inch (nominal) size with two seats of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gages shall have ranges and graduations as indicated. Accuracy shall be plus or minus 2 percent of scale range.

2.13 CONTROLLERS

2.13.1 Single-Loop Controllers

2.13.1.1 Controller Features

Controller shall be a microprocessor-based, single-loop device that does not require Contractor-generated software. Controller shall conform to FCC Part 15. Controller panel cutout shall be 3.62 by 3.62 inches. Controller shall have field selectable range for process variables, a remote setpoint analog input and analog output with adjustable high and low end limits, and proportional control manual reset adjustment. Analog output shall result from PID control. Analog output shall be configurable as direct acting and reverse acting. Controller shall have keyboard, display, auto/manual selection for control of analog output, and remote setpoint adjustment/local setpoint adjustment selection. Controller shall have adjustable high-end and low-end limits, ratio, and bias adjustments on remote setpoint input; operator initiated self-tune/manual-tune selection, anti-reset wind-up feature, and two configurable independent SPDT with adjustable system contact closure outputs. Controller shall be

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

configurable to power-up in manual with local setpoint control, in automatic with local setpoint control, and in automatic with remote setpoint control. Contact closures shall be activated by a process variable and by a process variable deviation from setpoint as configured. The range of hysteresis adjustment shall not be smaller than 1 percent to 5 percent of process variable input span. Controller shall power the analog output loop to 20 mA where connected to a load of 600 ohms. Controller shall have 5-year battery backup or shall have nonvolatile memory to store operating parameters.

2.13.1.2 Controller Parameter Input and Display

Control parameters shall be entered and displayed directly, in the correct engineering units, through a series of keystrokes on a front panel display with a 3-1/2-digit, seven-segment display, with decimal point and polarity indication. Use of the display shall allow manual interrogation of setpoint, mode constants, and values of process variables and outputs.

2.13.1.3 Controller Electrical Requirements

Controller shall be powered by 120 Vac. Controller shall provide electrical noise isolation, not less than 100 dB at 60 Hz common mode rejection ratio, and not less than 60 dB at 60 Hz normal mode rejection ratio between ac power line and process variable input, remote setpoint input, and output signals.

2.13.1.4 Controller Accuracy

Controller shall have an accuracy of plus or minus 0.30 percent of input span, plus or minus one digit.

2.13.1.5 Controller Self Tuning

Controller self-tuning operation shall apply proportional, integral, and derivative modes of control; mode constants shall be modified as required. Self tuning shall only operate when selected from the front panel.

2.13.1.6 Controller Manual Tuning

Controller manual tuning operation shall provide proportional, integral, and derivative control modes, or any combination thereof, by means of individual mode constant adjustments. Adjustments shall be set for the appropriate value if a particular control mode action is desired, or to zero for the particular mode not desired. The proportional mode constant shall be adjustable from 0 to 200 percent of input signal range; the integral mode constant shall be adjustable from 0 to 20 repetitions per minute; and the derivative mode constant shall be adjustable from 0 to 5 minutes.

2.13.2 Analog Electronic Controllers

Controllers shall be solid-state electronic devices which sense the difference between input sensor analog values (resistance or voltage) and setpoint adjustment analog values (resistance or voltage), and shall amplify the difference signal to provide the output signal. Controllers shall include the following:

- a. Proportional band: 2.5 to 33 percent of input device span.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- b. Authority: minimum of 33 to 200 percent.
- c. Inputs: thermistor, resistance, transmitter, or output of other electronic controllers.
- d. Outputs: within the range of minus 5 to 20 Vdc or a 4 to 20 mA dc current loop.
- e. Remote setpoint adjustment (SPA): plus or minus 10 percent of input device span.

2.13.3 Unitary Control Systems

Unitary control systems shall be energy-efficient, micro-processor-based temperature controllers and associated devices that do not require Contractor-generated software. Provide control systems with integral sensor as indicated. Controllers shall operate heating, cooling, and ventilating modes with independent occupied and unoccupied settings for each of 7 consecutive days. Cooling shall be controlled in two steps and heating shall be controlled in two steps with modulating control provided for the ventilation mode. Provide temperature changeover control to limit the ventilation mode when outdoor air temperature is not sufficiently low for "free-cooling." Provision shall be made for automatic changeover between heating and cooling modes, providing a one minute minimum time delay between the start and stop operation of heating and cooling stages upon startup and after power failure to prevent short cycling and power surges. Provide an optimum startup program to minimize warm-up or cool-down periods prior to the occupied mode. Outside air dampers shall be closed during the optimum startup program unless outside air is beneficial for cool-down in lieu of mechanical cooling. Fan shall operate continuously during the occupied mode and shall cycle during the unoccupied mode for heating or cooling. Provide battery backup to retain programs and maintain clock operation for 48 hours minimum during power outages. Controller shall have a self-diagnostic program to indicate errors and locking covers to prevent unauthorized program entries. Provide a convenient means to restore the occupied mode of operation for a minimum 2-hour period without removing covers. An indexing switch shall allow operation in a continuous unoccupied mode during abnormal periods without changing normal programs. Servicing tool required to place the unitary control system in use shall be a hand-held device used to adjust and monitor setpoints, controlled device positions, input sensor values, and other control system parameters.

2.14 CONTROL DEVICES AND ACCESSORIES

Provide control devices and accessories.

2.14.1 Function Modules

Function modules shall accept mA dc analog input signals to produce analog output signals or contact output signals. Modules shall have zero and span adjustments for analog outputs, and setpoint adjustments for contact outputs.

2.14.1.1 Minimum Position Switches and Temperature Setpoint Devices

Minimum position switches and temperature setpoint devices shall accept manual input and shall produce steady analog output. Switches and devices

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

shall be suitable for recessed wall mounting or panel mounting and shall have a graduated dial.

2.14.1.2 Signal Inverter Modules

Signal inverter modules shall accept analog input signal and produce analog output signal that linearly reverses the direction of signal change of input versus output.

2.14.1.3 High-Low Signal Selector Modules

High-low signal selector modules shall accept analog input signals and select either the highest or the lowest input signal as the output signal.

2.14.1.4 Sequencer Modules

Sequencer modules shall provide fixed time delayed sequencing of one or more contact transfers from an analog input signal. Sequencers shall return contacts to their zero input signal condition when power is interrupted.

2.14.2 Relays

Relays shall be two-pole, double-throw (DPDT) with a 10-ampere resistive rating at 120 Vac, and shall have an enclosed coil. Provide with a light indicator which is lit when the coil is energized and is not lit when the coil is not energized.

2.14.3 Time-Delay Relays

Time-delay relays shall be DPDT with octal connectors and dust covers. The adjustable timing range shall be 0 to 3 minutes .

2.14.4 Time Clocks

Time clocks shall be a 24-hour, 365-day programmable timing device with two independently timed circuits. Clocks shall have a manual scheduling keypad and alphanumeric display of timing parameters. Timing parameters shall include Gregorian calendar date for month, day and day-of-month indication; and 24-hour time-of-day display, with one-minute resolution for programming the ON and OFF times for each circuit. Circuits shall have programmable timed override from 1 to 99 minutes. Clocks shall have capacity for programming four ON events and four OFF events for each circuit. Programmed events shall be assignable to a 365-day schedule. Clocks shall have automatic standard time and daylight saving time adjustments, keyed to input of appropriate dates. Provide clocks with 4-day battery backup.

2.14.5 Override Timer

Override timers shall be manually set, mechanically driven timers, or electronic timers, without a "hold" feature. Time intervals shall be selectable for up to 12 hours of operation and shall expire unless reset.

2.14.6 Regulated Power Supplies

Power supplies shall provide a 24-Vdc linear supply at not less than 2 amperes, with regulation to 0.05 percent of output voltage. Power supplies shall have a fused input, and shall be protected from voltage

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

surges and power-line transients. Power supply output shall be protected against overvoltage and short circuits. Power supply loading shall not be greater than 1.2 amperes.

2.14.7 Transformers

UL 508 and NEMA ST 1 as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for available voltage and secondaries wound for correct control circuit voltage. Transformers shall be sized so that connected loads equal 80 percent of rated capacity. Transformers shall be enclosed in rustproof, galvanized steel cabinets with conduit connections. Disconnect switch shall be provided on the primary side, and a fuse cutout on the secondary side. For systems serving or as indicated, provide backup power supply including transformers connected to the emergency power source. Provide for automatic switchover and alarm upon failure of primary control circuit.

2.14.8 Pilot Lights and Manual Switches

Device illumination shall be by light-emitting diode (LED) or neon lamp. Switches shall have operating levers and index plates showing switch positions and names of apparatus controlled or other appropriate designations.

2.15 HVAC SYSTEM CONTROL PANELS

Provide HVAC system control panels.

2.15.1 Panel Assembly

Panel shall be fabricated for bottom entry connection for control system electric power, control system wiring, interconnection of control systems, interconnection of starters, and external shutdown devices. Panel shall have an operating temperature rise of not greater than 20 degrees F above an ambient temperature of 100 degrees F.

2.15.2 Panel Electrical Requirements

Control panel shall be powered by nominal 120 Vac terminating at panel on terminal blocks. Instrument cases shall be grounded. Interior and exterior panel enclosures shall be grounded.

2.15.3 Enclosures

Enclosures for each panel shall be a single door, wall-mounted box conforming to NEMA 250 with a continuous hinged and gasketed exterior door with a print pocket, key lock, and interior back panel. Inside finish shall be white enamel, and outside finish shall be gray primer over phosphatized surfaces.

2.15.4 Mounting and Labeling

Provide pilot lights, switches, panel-mounted control devices, and pressure gages shall be mounted on the door. Power conditioners, fuses, and duplex outlets shall be mounted on the interior of the cabinet. Other components housed in the panel shall be mounted on the interior back panel surface of the enclosure and shall be identified by plastic or metal nameplates which are mechanically attached to the panel. Lettering shall be cut or stamped into the nameplate to a depth of not less than 1/64 inch,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

and shall have contrasting color, produced by filling with enamel or lacquer or by use of laminated material. Painting of lettering directly on the surface of the door or interior back panel is not permitted.

2.15.5 Wiring

- a. Electric, electronic, and electropneumatic device signals entering and leaving the panel shall be wired to identified terminal blocks.
- b. Wiring shall be installed in wiring ducts so that devices can be added or replaced without disturbing existing wiring that is not affected by the change. Wiring to single-loop controllers shall have a 4 inch wiring loop in the horizontal wiring duct at each wiring connection. There shall be no wiring splices within the control panel. Interconnections required for power or signals shall be made on device terminals, if available, or panel terminal blocks, with not more than two wires connected to each terminal.
- c. Instrument signal grounds at the same reference level shall end at a grounding terminal connected to a common ground point for that level. Wiring shield grounds at the same reference level shall end at a grounding terminal connected to a common ground point for that level. Grounding terminal blocks shall be identified by reference level.
- d. Wiring connected to controllers shall be identified by function and polarity, e.g., process variable input and remote setpoint input and output.

2.16 ELECTRONIC VARIABLE AIR VOLUME VAV TERMINAL UNIT CONTROLS

Provide electronic VAV terminal unit controls.

2.16.1 VAV Terminal Units

VAV terminal units shall be as specified in Section 23 30 00 HVAC AIR DISTRIBUTION.

2.16.2 Terminal Unit Controls

- a. UL 916 and FCC Part 15. Controls for pressure independent boxes shall consist of a velocity sensing device in the primary air entering box, a room temperature sensing element, a damper actuator, and an adjustable microprocessor-based VAV box controller. Controls shall operate a damper for cooling and a duct coil for heating. Actuator shall open or close the device to which it is applied within 6 minutes.
- b. Controls for pressure independent boxes with recirculating fans shall consist of a velocity sensing device in the primary air entering the box, a room temperature sensing element, an adjustable microprocessor-based VAV box controller, a damper with actuator, and a duct pressure switch to operate the recirculation fan. Controller shall operate the damper for cooling and the recirculating fan and duct coil for heating.
- c. One hand-held communication and programming device with an instruction manual, plus one additional hand-held communication device and instruction manual per 100 terminal units, shall be provided. Communication and programming device shall connect directly to the controller or to a jack at the room temperature sensing element

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

location. Communication and programming device shall be used to read and set minimum velocity, maximum velocity, heating setpoint, and cooling setpoint, and to read air velocity and space temperature.

2.17 CONTROL WIRING

Provide HVAC control tubing and wiring.

2.17.1 Wiring

- a. Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanisms. Terminal blocks shall be rail mounted, and shall have end plates, partition plates or enclosed sides for separation.
- b. Control wiring for 24-V circuits shall be 18 AWG minimum and shall be rated for 300-V service.
- c. Wiring for circuits operating at more than 100 V shall be 14 AWG minimum and shall be rated for 600-V service.
- d. Analog signal wiring circuits within control panels shall not be less than 20 AWG and shall be rated for 300-V service.
- e. Instrumentation cable shall be 18 AWG, stranded copper, single or multiple twisted, minimum 2-inch lay of twist, 100 percent shielded pairs, and shall have 300-V insulation. Each pair shall have a 20-AWG tinned copper drain wire, individual pair, and overall insulation. Cables shall have an overall aluminum polyester or tinned overall copper cable shield tape, 20-AWG tinned-copper cable drain wire, and overall cable insulation.
- f. Nonconducting wiring ducts in control panels shall have slotted side snap-on covers, fittings for connecting ducts, mounting clips for securing ducts, and wire retaining clips.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation under the supervision of competent technicians regularly employed in the installation of control systems. Provide components for a complete and operational control system. Provide control system complete and ready for operation, as specified and indicated. Provide dielectric isolation where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be watertight. Control system installation shall provide adequate clearance for control system maintenance by maintaining access spaces between coils, to mixed-air plenums, and as required to calibrate, remove, repair, or replace control system devices. Control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance. Install devices mounted in or on piping or ductwork, on building surfaces, in mechanical and electrical spaces, or in occupied space ceilings in accordance with manufacturer's recommendations and as indicated on contract documents. Provide control devices to be installed in piping and ductwork with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Certify that installation of control system is complete and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

technical requirements of this section have been met.

3.1.1 Sensors

Provide sensors in locations to sense the appropriate condition. Install sensor and transmitter where easily accessible and serviceable without special tools. Sensors shall be calibrated to the accuracy specified in the contract, and operate correctly when installed. Do not install sensors designed for one application in the place of another application (e.g., replacing a duct sensor with a room sensor).

3.1.1.1 Room Sensors

Provide on interior walls to sense average room conditions. Avoid locations which may be covered by office furniture. Do not mount room sensors on exterior walls if other locations are available. Mount centerline of sensor 5 feet above finished floor.

3.1.1.2 Duct Temperature Sensors

Provide sensors in ductwork in general locations as indicated. Select specific sensor location within duct to accurately sense appropriate air temperatures. Locate sensor connection boxes in position not obstructed by ducts or equipment. Install gaskets between sensor housing and duct wall. Seal duct and insulation penetrations. Install duct averaging sensors between two rigid supports in serpentine position to sense average conditions. Sensor shall have a total minimum length of one linear foot per 4 square feet of duct area. Sensor shall be mounted a minimum of 3 inches from outside wall surface. Thermally isolate temperature sensing elements from supports. Provide duct access doors to averaging sensors.

3.1.1.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring temperatures in liquid applications or pressure vessels. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to effect proper flow across entire area of the well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Temperature sensors shall be installed in thermowells with thermal transmission material to speed the response of temperature measurement. Provide thermowells with sealing nuts to contain thermal transmission material.

3.1.1.4 Strap-on Temperature Sensors

Strap-on temperature sensors, using helical screw stainless steel clamps, shall be permitted on new hot water piping for on-off operation, and for existing hot water piping sizes not greater than 3 inches. Clean the pipe to bright metal. Insulate strap-on bulb and pipe after installation. Provide other liquid temperature sensors with thermowells. Provide NEMA 250 Type 4 enclosures for outdoor installations. Provide brushed aluminum or brushed stainless steel enclosures for sensors located in finished spaces.

3.1.1.5 Outside Air Temperature Sensors

Provide outside air temperature sensor on north side of building, away from exhaust hoods, air intakes, and other areas which may affect

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

temperature readings. Install sunshields to protect outside air temperature sensor from direct sunlight.

3.1.1.6 Low-Temperature Protection Thermostats (Freezestats)

Provide thermostat for each 80 square feet of coil-face area to sense the temperature at location indicated. Install thermostat sensing element in serpentine pattern.

3.1.2 Thermometers

Provide thermometers which are installed in liquid systems in thermowells with thermal transmitting materials within the well to speed the response of temperature measurement.

3.1.3 Pressure Sensors

3.1.3.1 Duct Static Pressure

Duct static pressure sensor shall be located where indicated on drawings. If no location is indicated, it should be located approximately two-thirds of distance from supply fan to the end of duct with greatest pressure drop.

3.1.3.2 Steam Pressure

Provide snubbers and isolation valves on steam pressure sensing applications.

3.1.4 Pressure Gages

Provide snubbers for gages in piping systems subject to pulsation. Gages for steam service shall have pigtail fittings with cocks. Install pressure gages at locations indicated. Pneumatic output lines shall have pressure gages mounted near the control panel.

3.1.5 Valves

Provide valve with stems upright where possible but with stems not lower than horizontal. Provide positioners where indicated and where necessary to prevent overlap of heating and cooling where one controller operates more than one pneumatic device and to maintain the proper dead band between heating and cooling.

3.1.6 Damper Actuators

Provide damper actuators so that the damper sealing action is smooth and sufficient to maintain leakage at or below specified leakage rate. Multiple actuators operating a common damper shall be connected to a common drive shaft. Provide positioners where indicated and where necessary to prevent overlap of heating and cooling where one controller operates more than one pneumatic device and to maintain the proper dead band between heating and cooling.

3.1.7 Access Doors

Provide access doors in ductwork to service airflow monitoring devices, devices with averaging elements, and low-temperature protection thermostats (freezestats).

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.8 Wiring

- a. Provide wiring external to control panels, including low-voltage wiring, in metallic raceways. Install wiring without splices between sensors, transmitters, control devices, and HVAC control panels. Install instrumentation grounding as necessary to prevent ground loops, noise, and surges adversely affecting operation of the system. Tag cables, conductors, and wires at both ends, with identifiers indicated on shop drawings.
- b. Other electrical work shall be specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide step-down transformers where control equipment operates at lower than line circuit voltages. Transformers serving individual heating, ventilating, and air-conditioning units shall be fed from fan motor leads, or fed from the nearest distribution panelboard or motor control center, using circuits provided for that purpose.
- c. Ground control panels and cabinets as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Grounding of the green ac ground wire at the breaker panel alone is not adequate. Install ground wire from each control panel to adequate building ground.

3.1.9 Foundations and Housekeeping Pads

Provide 3 inch high concrete foundations and housekeeping pads for the HVAC control system air compressors.

3.1.10 Control Drawings

Post laminated copies of as-built control system drawings in each mechanical room.

3.2 ADJUSTMENTS

Calibrate instrumentation and controls, and verify specified accuracy using test equipment traceable to National Institute for Science and Technology (NIST) standards. Adjust controls and equipment to maintain conditions indicated, to perform the functions indicated, and to operate in the sequence specified.

3.3 FIELD QUALITY CONTROL

- a. Demonstrate compliance of HVAC control systems. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Calibrate test equipment in accordance with NIST standards. Ensure that tests are performed or supervised by competent employees of the control system installer or the control system manufacturer regularly employed in testing and calibration of control systems.
- b. Testing shall include field tests and the performance verification test. Field tests shall demonstrate proper calibration of instrumentation, input and output devices, and operation of specific equipment. The performance verification test shall ensure proper execution of sequence of operation and proper tuning of control loops.
- c. The plan for each phase of field acceptance testing shall be approved in writing before beginning that phase of testing. Furnish written

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

notification of planned testing to Contracting Officer at least 21 days prior to testing. Include proposed test procedures with notification. The Contractor will not be allowed to start testing without written Government approval of test procedures. Test procedures shall consist of detailed instructions for complete testing to prove the performance of heating, ventilating, and air-conditioning system and control system. Include the following tests in test procedures.

- d. Submit original copies of data produced, including results of each test procedure, to the Government at the conclusion of each phase of testing. Tests are subject to supervision and approval by Contracting Officer. Do not perform testing during scheduled seasonal off-periods of heating and cooling systems.

3.3.1 Test Reporting

After completion or termination of field tests and again after the performance verification test, identify, determine causes, replace, repair, or calibrate equipment which fails to meet the specification; and deliver a written report to the Government. The report shall document test results, explain in detail the nature of each failure, and corrective action taken. After delivering the performance verification test report, the Contractor shall convene a test review meeting at the job site to present results and recommendations to the Government. As a part of the test review meeting, the Contractor shall demonstrate by performing appropriate portions of field tests or the performance verification test that failures have been corrected. Based on Contractor's report and test review meeting, the Government will determine either the restart point or successful completion of testing. Do not commence required retesting until after receipt of written notification by the Government. At the conclusion of retesting, repeat the assessment.

3.3.2 Contractor's Field Testing

Calibrate field equipment and verify equipment and system operation before system is placed on-line. Include the following tests in field testing.

3.3.2.1 System Inspection

Observe HVAC control system in shutdown condition. Check dampers and valves for proper normal positions. Document positions for the performance verification test report.

3.3.2.2 Calibration Accuracy and Operation of Input Test

Verify correct calibration and operation of input instrument. For each sensor and transmitter, including for temperature, pressure, relative humidity, and dew point inputs, record the reading at the sensor or transmitter location using calibrated test equipment. Record the output reading provided by that sensor or transmitter. Document each of these location and output readings for the performance verification test report. The test equipment shall have been calibrated within one year of the date of use in the field. Test equipment calibration shall be traceable to the measurement standard of the National Institute of Standards and Technology.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.3.2.3 Operation of Output Test

Check the operation of output to verify correct operation. Operate analog device to minimum range (e.g., 4 mA) and maximum range (e.g., 20 mA), and measure and record actual output values.

3.3.2.4 Actuator Range Adjustment

With the controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position through to the full range of stroke position. Record actual spring ranges and normal positions for modulating control valves and dampers.

3.3.3 Coordination with HVAC System Balancing

Tune the control system after air and hydronic systems have been balanced, minimum damper positions have been set, and a report has been issued.

3.3.4 Field Test Documentation

Before scheduling the performance verification test, provide field test documentation and written certification of completion to Contracting Officer and the Naval Energy and Environmental Support Activity (NEESA), that the installed system has been calibrated, tested, and is ready to begin the performance verification test. Do not start the performance verification test prior to receiving written permission from the Government.

3.3.5 Performance Verification Test

Conduct the performance verification tests to demonstrate that the control system maintains setpoints and that the control loops are tuned for the correct sequence of operation. Conduct the performance verification test during one week of continuous HVAC and control systems operation and before final acceptance of work. Specifically, the performance verification test shall demonstrate that the HVAC system operates properly through the complete sequence of operation (e.g., seasonal, occupied and unoccupied, warm up), for specified control sequences. Demonstrate proper control system response for abnormal conditions for which there is a specified system or controls response by simulating these conditions. Demonstrate that hardware interlocks and safety devices work as designed. Demonstrate that the control system performs the correct sequence of control.

3.3.6 Opposite Season Test

Repeat the performance verification test during an opposite season to the first performance verification test.

3.4 TRAINING

Provide a qualified instructor to conduct training courses for designated personnel in maintenance and operation of HVAC and control systems. Orientate training to the specific system being installed under the contract. Furnish audiovisual equipment and other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15-minute breaks and excluding lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, assume that the attendees have a high school

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

education and are familiar with HVAC systems. Submit planned training schedule, agenda, and class materials to the Government at least 45 days prior to training.

3.4.1 Training Course Documentation

Training shall be based on the operation and maintenance manuals and control system training manual. Deliver manuals for each trainee with two additional sets for archiving at the project site. Include an agenda, defined objectives, and a detailed description of subject matter for each lesson.

3.4.2 Operator Training I

The first class shall be taught for a period of 5 consecutive training days at least one month prior to the scheduled performance verification test. The first course shall be taught in a Government-provided facility on base. Training shall be classroom instruction, but have hands-on operation of similar digital controllers. Maximum of 5 personnel shall attend the course. Upon completion of course, each student, using appropriate documentation, shall be able to perform elementary operations, with guidance, and describe general hardware and functionality of the system. Course shall include but not be limited to description of hardware and operation of the system.

3.4.3 Operator Training II

The second course shall be taught in the field, using the operating equipment at project sites for a total of 16 hours of instruction per student, in blocks of 4 hours. Maximum of 5 personnel shall attend the course. Include hands-on training under constant monitoring of instructor. Course content shall duplicate the Operator Training I course as applied to the installed system. Instructor shall determine the level of the password to be issued to each student before each session. Upon completion of the course, students shall be proficient in system operation. Prepare a written report describing the skill level of each student at the end of the course.

3.4.4 Operator Training III

The third course shall be taught in the field, at the project site, for a period of 3 training days no later than 6 months after completion of endurance test. Maximum of 5 personnel shall attend the course. Course shall be structured to address specific topics that the students need to discuss and to answer questions concerning operation of the system. Upon completion of the course, students shall be proficient in system operation and shall have no unanswered questions regarding operation of the installed system.

3.4.5 System Maintenance Training

Course shall be taught at the project site within one month after completion of endurance test for a period of 2 training days. Maximum of 2 personnel shall attend the course. Course shall include but not be limited to the following:

- a. Physical layout for each piece of hardware
- b. Troubleshooting and diagnostics procedures

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- c. Repair instructions
- d. Preventive maintenance procedures and schedule
- e. Calibration procedures

3.5 QUALIFIED SERVICE ORGANIZATION LIST

The qualified service organization list shall include names and telephone numbers of organizations qualified to service HVAC control systems.

3.6 COMMISSIONING

Commissioning of control systems is specified in the pre-field TAB engineering report described in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 09 93

SEQUENCES OF OPERATION FOR HVAC CONTROL 11/15

PART 1 GENERAL

1.1 DEFINITIONS

For definitions related to this Section, see Section 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC.

1.2 SUBMITTALS

Submittals related to this Section are specified in Section 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC.

PART 2 PRODUCTS

Products related to this Section are specified in Section 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC and related Sections 23 09 13
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC and 23 09 23.01 LONWORKS
DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS or
23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING
CONTROL SYSTEMS.

PART 3 EXECUTION

3.1 SEQUENCES OF OPERATION FOR OCCUPANCY SCHEDULING

3.1.1 System Mode

Operate air handling units (AHUs) in Occupied, Warm-Up-Cool-Down, or
Unoccupied modes as specified. VAV boxes, Fan Coils, and operate other
terminal equipment in Occupied or Unoccupied modes as specified.
Chillers, boilers, and other sources of heating/cooling for hydronic loads
do not require scheduling; these systems receive requests for
heating/cooling from their loads.

3.1.2 System Scheduler Requirements

The System Scheduler functionality must reside in either a piece of DDC
Hardware dedicated to this functionality or in the DDC Hardware
controlling the system AHU. A single piece of DDC Hardware dedicated to
scheduling (performing no other control functionality) may contain
multiple System Schedulers. Provide a unique System Scheduler for: each
AHU including it's associated Terminal Units, and each stand-alone
Terminal Unit (those not dependent upon AHU service). Each System
Scheduler must provide the following functionality:

3.1.2.1 Scheduled Occupancy Input

Accept network variable of type SNVT_occupancy. Support the following
possible values: OC_STANDBY, OC_OCCUPIED and OC_UNOCCUPIED.

3.1.2.2 Occupancy Override Input

Accept network variable of type SNVT_occupancy. Support the following

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

possible values: OC_STANDBY, OC_OCCUPIED, OC_UNOCCUPIED, and OC_NUL.

3.1.2.3 Space Occupancy Inputs

For systems with multiple occupancy sensors, accept multiple inputs of network variable type SNVT_Occupancy. Support the following possible values: OC_OCCUPIED, OC_UNOCCUPIED, and OC_NUL. For systems with a single occupancy sensor, accept a network variable input of type SNVT_Occupancy or a hardware binary input (BI) indicating the space occupancy status as Occupied or Unoccupied.

3.1.2.4 Air Handler Occupancy Output

For a System Scheduler for a system containing an air handler, output one or more SNVTs indicating the desired occupancy status as one of the following possible values: Warm-Up-Cool-Down (when required by the AHU Sequence of Operation), Occupied and Unoccupied.

3.1.2.5 Terminal Unit Occupancy Output

For a System Scheduler for a stand-alone terminal unit, or a group of terminal units served by a single air handler, output one or more SNVTs indicating the desired occupancy status as one of the following possible values: Occupied and Unoccupied.

3.1.2.6 Default Schedule

Incorporate a 24-hour 7-day default schedule as shown on the drawings which may be activated and deactivated by the System Scheduler Logic.

3.1.2.7 Communication Determination

Determine the time elapsed between receipts of the scheduled occupancy input SNVT, and use this elapsed time to activate and deactivate the Default Schedule as specified. (This provides the capability for the system scheduler to use its Default Schedule if it loses communication with the UMCS).

3.1.3 System Scheduler Output Determination

For controlling an Air Handler, interpret a SNVT input of OC_STANDBY as Warm-Up-Cool-Down if the sequence of operation supports that mode, otherwise interpret OC_STANDBY as Occupied. For Terminal Units, interpret OC_STANDBY as Occupied.

3.1.3.1 Air Handler Occupancy Output

If more than 95 minutes have passed since the last receipt of the Scheduled Occupancy input, determine the Air Handler Occupancy Output by the default schedule and the Space Occupancy Inputs. Otherwise, determine the output as follows:

- a. If the Override Occupancy Input is not OC_NUL, determine the Air Handler Occupancy Output from the Override Occupancy Input.
- b. Otherwise, if at least the required number (as shown on the Occupancy Schedule Drawing) of Space Occupancy Inputs are OC_OCCUPIED or the hardware BI is Occupied the Air Handler Occupancy Output must be OC_OCCUPIED.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- c. Otherwise, determine the Air Handler Occupancy Output from the Scheduled Occupancy Input SNVT.

3.1.3.2 Terminal Unit Occupancy Output

If more than 95 minutes have passed since the last receipt of the Scheduled Occupancy input, determine the Terminal Unit Occupancy Output by the default schedule. Otherwise, determine the output as follows:

- a. If the Override Occupancy Input is not OC_NUL, determine the Terminal Unit Occupancy Output from the Override Occupancy Input SNVT:
- b. Otherwise, determine the Terminal Unit Occupancy Output from the Scheduled Occupancy SNVT.

3.1.4 Air Handler System Scheduling

- a. Bind the AHU Occupancy Output SNVT from the System Scheduler to the DDC Hardware that executes the Occupancy Mode Determination part of the Air Handler Sequence of Operation
- b. For Air Handlers using occupancy sensors, bind the output SNVT (of type SNVT_Occupancy) of each occupancy sensor to a Space Occupancy Input of the System Scheduler.
- c. Bind the Terminal Unit Occupancy Output SNVT from the System Scheduler to each AHU-Dependent Terminal Unit.
- d. AHU-Dependent Terminal Units with occupancy sensors must have the Effective Occupancy SNVT (of type SNVT_Occupancy) of each Terminal Unit bound to a Space Occupancy Input of the System Scheduler.

3.1.5 Stand-Alone Terminal Unit Scheduling

Bind the Terminal Unit Occupancy Output from the System Scheduler to the DDC Hardware that executes the Occupancy Mode Determination part of the Terminal Unit Sequence of Operation.

3.2 SEQUENCES OF OPERATION FOR AIR HANDLING UNITS

3.2.1 NOT USED

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs and outputs as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control must be proportional-integral (PI) control.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2.2 NOT USED

3.2.3 NOT USEDs

3.2.4 NOT USED

3.2.5 Single Zone with Heating and Cooling Coils and Return Air Bypass

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs and outputs as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control are proportional-integral (PI) control.

3.2.5.1 HAND-OFF-AUTO Switch

Provide supply fan motor starter to accept a Fire Alarm Panel (FAP) signal that takes precedence over all other starter inputs and switches and starts the fan. Provide fan motor starter which accepts an occupant accessible emergency shutoff switch as indicated. Provide supply fan motor starter with an H-O-A switch:

3.2.5.1.1 HAND

With the H-O-A switch in HAND position, start the supply fan and run continuously, subject to Safeties.

3.2.5.1.2 OFF

With the H-O-A switch in OFF position, stop the supply fan.

3.2.5.1.3 AUTO

With the H-O-A switch in AUTO position, run the supply fan subject to the Supply Fan Start/Stop (SF-SS) command and Safeties.

3.2.5.2 Occupancy Modes

Obtain the Occupancy Mode input from the System Scheduler as specified and shown. Operate the system in one of the following modes: Occupied, Unoccupied, or WarmUp/CoolDown.

3.2.5.3 System Enable and Loop Enable

3.2.5.3.1 Occupied Mode

Enable the supply fan (SYS-ENA) and command to run (SF-SS) and enable all control loops.

3.2.5.3.2 Unoccupied Mode

While the building temperature (BLDG-T) is above the low limit setpoint (BLDG-T-LL) disable all control loops and do not run the supply fan. When BLDG-T drops below BLDG-T-LL (with a 5 degrees F deadband), enable the supply fan (SYS-ENA) and command to run (SF-SS) and enable the Heating

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Coil Temperature Control loop. Disable all other control loops.

3.2.5.3.3 Warm Up / Cool Down Mode

Enable the supply fan (SYS-ENA) and command to run (SF-SS). Disable the Minimum Outside Air Flow Control loop and enable all other control loops.

3.2.5.4 Proofs and Safeties

The supply fan and all DDC Hardware control loops are subject to Proofs and Safeties. Direct-hardwire interlock safeties to the fan starter circuit as shown. Monitor all proofs and safeties and disable all control loops and command the AHU fan off until reset due to failure of any proof or activation of any safety.

3.2.5.4.1 Proofs

Supply fan status (proof) (SF-S)

3.2.5.4.2 Safeties

- a. Heating coil discharge air temperature low limit (freezestat) (HTG-DA-T-LL)
- b. Supply air smoke (SA-SMK)
- c. Return air smoke (RA-SMK)

3.2.5.4.3 DDC Hardware

Reset all proofs and safeties via a local binary push-button (RST-BUT) input to the DDC Hardware, via a remote command to the DDC Hardware via SNVT or both (where the Contractor provides both reset functions and the operator can use either one to perform the reset), as shown on the Points Schedule drawing.

3.2.5.5 Minimum Outside Air Flow Control

When this loop is enabled the DDC Hardware, open the 2-position minimum outside air damper to introduce the minimum outside air flow quantity as shown. When this loop is disabled, close the minimum outside air damper.

3.2.5.6 Economizer Damper Control

3.2.5.6.1 Enabled Loop

When this loop is enabled, and the Economizer is ON as determined by the Economizer Enable Logic, modulate the economizer outside air, return air, and relief air dampers (Economizer dampers) in sequence with the bypass and supply dampers and the heating coil control valve as shown to maintain zone temperature (ZN-T) at setpoint (ZN-T-SP) as shown.

3.2.5.6.2 Disabled Loop

When this loop is disabled, or the Economizer is OFF as determined by the Economizer Enable Logic, close the economizer outside air and relief air dampers, and open the return air damper.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2.5.6.3 Economizer Enable Logic

Ensure the economizer is ON when the outside air dry bulb temperature is between the high limit (ECO-HL-SP) and low limit (ECO-LL-SP) setpoints as shown. Otherwise the Economizer is OFF. Ensure ECO-HL-SP and ECO-LL-SP each have a 2 degrees F deadband.

3.2.5.7 Temperature Control Loop Heating Coil Control

When this loop is enabled, modulate the heating coil control valve, modulate the economizer dampers if enabled, open and close the 2-position cooling coil valve and modulate the bypass and supply air dampers in sequence to maintain zone temperature (ZN-T) at setpoint (ZN-T-SP) as shown. When this loop is disabled, close both valves and position the bypass and supply air dampers to bypass air.

3.2.6 Single Zone with Humidity Control

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs and outputs as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control are proportional-integral (PI) control.

3.2.6.1 HAND-OFF-AUTO Switch

Provide supply fan motor starter to accept a Fire Alarm Panel (FAP) signal that takes precedence over all other starter inputs and switches and starts the fan. Provide fan motor starter which accepts an occupant accessible emergency shutoff switch as indicated. Provide supply fan motor starter with an H-O-A switch:

3.2.6.1.1 HAND

With the H-O-A switch in HAND position, start the supply fan and run continuously, subject to Safeties.

3.2.6.1.2 OFF

With the H-O-A switch in OFF position, stop the supply fan.

3.2.6.1.3 AUTO

With the H-O-A switch in AUTO position, run the supply fan subject to the Supply Fan Start/Stop (SF-SS) command and Safeties.

3.2.6.2 Occupancy Modes

Obtain Occupancy Mode input from the System Scheduler as specified and shown. Operate the system in one of the following modes: Occupied, Unoccupied, or WarmUp/CoolDown.

3.2.6.3 System Enable and Loop Enable

3.2.6.3.1 Occupied Mode

Enable the supply fan (SYS-ENA) and command to run (SF-SS) and enable all control loops.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2.6.3.2 Unoccupied Mode

While the building temperature (BLDG-T) is above the low limit setpoint (BLDG-T-LL), disable all control loops and do not run the supply fan. When BLDG-T drops below BLDG-T-LL (with a 5 degrees F deadband), enable the supply fan (SYS-ENA) and command to run (SF-SS), enable the Preheat Coil Control loop and Reheat Coil Control loop and disable all other loops.

3.2.6.3.3 Warm Up / Cool Down Mode

Enable the supply fan (SYS-ENA) and command to run (SF-SS). Disable the Minimum Outside Air Flow Control loop and enable all other control loops.

3.2.6.4 Proofs and Safeties

The supply fan and all DDC Hardware control loops are subject to Proofs and Safeties. Direct-hardwire interlock safeties to the fan starter circuit as shown. Monitor all proofs and safeties and disable all control loops and command the AHU fan off until reset due to failure of any proof or activation of any safety.

3.2.6.4.1 Proofs

Supply fan status (proof) (SF-S)

3.2.6.4.2 Safeties

- a. Preheat coil discharge air temperature low limit (freezestat) (PH-DA-T-LL)
- b. Supply air smoke (SA-SMK)
- c. Return air smoke (RA-SMK)

3.2.6.4.3 DDC Hardware

Reset all proofs and safeties via a local binary push-button (RST-BUT) input to the DDC Hardware, via a remote command to the DDC Hardware via SNVT or both (where both reset functions are provided and the operator can use either one to perform the reset), as shown on the Points Schedule drawing.

3.2.6.5 Minimum Outside Air Flow Control

When this loop is enabled, open the 2-position minimum outside air damper to introduce the minimum outside air flow quantity as shown. When this loop is disabled, close the minimum outside air damper.

3.2.6.6 Preheat Coil Control Loop

When this loop is enabled, modulate the preheat coil valve to maintain the preheat coil discharge air temperature (PH-DA-T) at setpoint (PH-DA-T-SP) as shown. When this loop is disabled, close the preheat coil valve.

3.2.6.7 Cooling-and-Dehumidification Coil Control

When this loop is enabled, modulate the cooling and dehumidification valve to maintain either the zone temperature (ZN-T) at setpoint (ZN-T-SP) or zone relative humidity (ZN-RH) at setpoint (ZN-RH-SP), whichever calls for

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

more chilled water flow. Modulate the valve in sequence with the reheat valve and humidification valve as shown to avoid simultaneous cooling and reheating, and simultaneous dehumidification and humidification. When this loop is disabled, close the coil valve.

3.2.6.8 Reheat Coil Control

When this loop is enabled, modulate the reheat coil valve to maintain the zone temperature (ZN-T) at setpoint (ZN-T-SP) as shown. Modulate the valve in sequence with the cooling-and-dehumidification valve as shown to avoid simultaneous cooling and reheating. When this loop is disabled, close the coil valve.

3.2.6.9 Humidification Control

When this loop is enabled, modulate the humidifier valve to maintain zone relative humidity (ZN-RH) at setpoint (ZN-RH-SP). Modulate the valve in sequence with the cooling-and-dehumidification valve as shown to avoid simultaneous dehumidification and humidification. When the supply air duct humidity (SA-RH) rises above 80 percent relative humidity, begin modulating the humidifier valve towards closed and continue to gradually move towards closed until the supply air duct humidity reaches 90 percent relative humidity, at which point the humidifier valve is fully closed. When this loop is disabled, close the humidifier valve.

3.2.7 Multizone without Return Fan

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs and outputs as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control are proportional-integral (PI) control.

3.2.7.1 HAND-OFF-AUTO switches and Fire Alarm Panel (FAP) Signal:

Supply Fan VFD. Provide supply fan motor starter to accept a Fire Alarm Panel (FAP) signal that takes precedence over all other starter inputs and switches and starts the fan. Provide fan motor starter which accepts an occupant accessible emergency shutoff switch as shown. Provide supply fan motor starter with an H-O-A switch:

3.2.7.1.1 HAND

With the H-O-A switch in HAND position, the supply fan starts and runs continuously, subject to Safeties.

3.2.7.1.2 OFF

With the H-O-A switch in OFF position, the supply fan stops.

3.2.7.1.3 AUTO

With the H-O-A switch in AUTO position, the supply fan runs subject to the Supply Fan Start/Stop (SF-SS) command and Safeties.

3.2.7.2 Return Fan VFD

Incorporate an integral H-O-A switch, manual speed adjustment and also accept a Fire Alarm Panel (FAP) signal. Run the return fan according to the following inputs (in order of decreasing priority):

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- a. Use FAP signal to cause the RF to run at 100 percent
- b. Connect SF-S (proof) to the RF VFD safety circuit such that if SF is not running, RF is off.
- c. Use RF H-O-A switch to select RF mode as follows:
 - (1) When switch is in Hand, run fan. Ensure fan speed is under manual control.
 - (2) When switch is in Off, fan is off.
 - (3) When switch is in Auto, run fan. Ensure fan speed is under control of the DDC Hardware.

3.2.7.3 Occupancy Modes

Obtain Occupancy Mode input from the System Scheduler as specified and shown. Operate the system in one of the following modes: Occupied, Unoccupied, or WarmUp/CoolDown.

3.2.7.4 System Enable and Loop Enable

3.2.7.4.1 Occupied Mode

Enable the supply fan (SYS-ENA) and command to run (SF-SS). Enable all control loops. Also enable the Zone Temperature Control loops serviced by the AHU.

3.2.7.4.2 Unoccupied Mode

While the building temperature (BLDG-T) is above the low limit setpoint (BLDG-T-LL), disable all control loops and do not run the supply fan. When BLDG-T drops below BLDG-T-LL (with a 5 degrees F deadband), enable the supply fan (SYS-ENA) and command to run (SF-SS), enable the Hot Deck Coil Control loop and all Zone Temperature Control loops, and disable all other control loops.

3.2.7.4.3 Warm Up / Cool Down Mode

Enable the supply fan (SYS-ENA) and command to run (SF-SS). Disable the Minimum Outside Air Flow Control loop and enable all other control loops. Also enable the Zone Temperature Control loops serviced by the AHU.

3.2.7.5 Proofs and Safeties

The supply fan and all DDC Hardware control loops are subject to Proofs and Safeties. Direct-hardwire interlock safeties to the fan starter circuit as shown. Monitor all proofs and safeties and disable all control loops and command the AHU fan off until reset due to failure of any proof or activation of any safety.

3.2.7.5.1 Proofs

- a. Supply fan status (proof) (SF-S)
- b. Return fan status (proof) (RF-S)

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2.7.5.2 Safeties

- a. Mixed air temperature low limit (freeze stat) (MA-T-LL)
- b. Return air smoke (RA-SMK)

3.2.7.5.3 DDC Hardware Reset

Reset all proofs and safeties via a local binary push-button (RST-BUT) input to the DDC Hardware, via a remote command to the DDC Hardware via SNVT or both (where the Contractor provides both reset functions and the operator can use either one to perform the reset), as shown on the Points Schedule drawing.

3.2.7.6 Minimum Outside Air Flow Control

When this loop is enabled, open the 2-position minimum outside air damper to introduce the minimum outside air flow quantity as shown. When this loop is disabled, close the minimum outside air damper.

3.2.7.7 Mixed Air Temperature Control With Economizer

3.2.7.7.1 Enabled Loop

When this loop is enabled, and the Economizer is ON as determined by the Economizer Enable Logic, modulate the economizer outside air, relief, and return air dampers to maintain the mixed air temperature (MA-T) at setpoint (MA-T-SP) as shown.

3.2.7.7.2 Disabled Loop

When this loop is disabled, or the Economizer is OFF as determined by the Economizer Enable Logic, close the economizer outside air and relief air dampers, and open the return air damper.

3.2.7.7.3 Economizer Enable Logic

Ensure the economizer is ON when the outside air dry bulb temperature is between the high limit (ECO-HL-SP) and low limit (ECO-LL-SP) setpoints as shown. Otherwise the Economizer is OFF. Ensure ECO-HL-SP and ECO-LL-SP each have a 2 degrees F deadband.

3.2.7.8 Hot Deck Coil Control

3.2.7.8.1 Enabled Loop

When this loop is enabled, modulate the hot deck heating coil valve to maintain the hot deck temperature (HD-T) at setpoint (HD-T-SP) as shown. When this loop is disabled, close the hot deck coil valve.

3.2.7.9 Cold Deck Coil Control

When this loop is enabled, modulate the cold deck cooling coil valve to maintain the cold deck temperature (CD-T) at setpoint (CD-T-SP) as shown. When this loop is disabled, close the cold deck cooling coil valve.

3.2.7.10 Zone Temperature Control

When this loop is enabled:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2.7.10.1 Zone Temperature Setpoint

Ensure zone temperature setpoint (ZN-T-SP) is at the configured setpoint or at the occupant-adjustable setpoint via the wall-mounted thermostat, as shown.

3.2.7.10.2 DDC Hardware Modulation

Modulate the hot deck and cold deck dampers to maintain zone temperature (ZN-T) at setpoint (ZN-T-SP).

3.2.8 NOT USED

3.2.9 Variable Air Volume System without Return Fan

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs and outputs as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control is proportional-integral (PI) control.

3.2.9.1 HAND-OFF-AUTO Switches

Provide supply fan variable frequency drive (VFD) unit to accept a Fire Alarm Panel (FAP) signal that takes precedence over all other VFD inputs and switches and causes the VFD to run at 100 percent speed. Provide VFD that accepts an occupant accessible emergency shutoff switch as shown. Provide supply fan variable frequency drive (VFD) unit with an integral H-O-A switch:

3.2.9.1.1 HAND

With the H-O-A switch in HAND position, start the supply fan and run continuously, subject to Safeties. Ensure fan speed is under manual-operator control.

3.2.9.1.2 OFF

With the H-O-A switch in OFF position, stop the supply fan.

3.2.9.1.3 AUTO

With the H-O-A switch in AUTO position, run the supply fan subject to the Supply Fan Start/Stop Signal (SF-SS) and Safeties. Ensure fan speed is under control of the DDC Hardware.

3.2.9.2 NOT USED

3.2.9.3 Occupancy Modes

Obtain Occupancy Mode input from the System Scheduler as specified and shown. Operate the system in one of the following modes: Occupied, Unoccupied, or Warm Up/Cool Down.

3.2.9.4 Proofs and Safeties

The supply fan and all DDC Hardware control loops are subject to Proofs and Safeties. Direct-hardwire interlock safeties to the VFD as shown. Monitor all proofs and safeties and disable all control loops and command

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

the AHU fan off until reset due to failure of any proof or activation of any safety.

3.2.9.4.1 Proofs

- a. Supply fan status (SF-S)

3.2.9.4.2 Safeties

- a. Preheat coil discharge air temperature low limit (freezestat) (PH-DA-T-LL) for systems with a preheat coil. Cooling coil discharge air temperature low limit (freezestat) (CLG-DA-T-LL) for all other systems
- b. Supply air duct pressure high limit (SA-P-HL)
- c. Supply air smoke (SA-SMK)
- d. Return air smoke (RA-SMK)

3.2.9.4.3 DDC Hardware Reset

Reset all proofs and safeties via a local binary push-button (RST-BUT) input to the DDC Hardware, via a remote command to the DDC Hardware via SNVT or both (where the Contractor provides both reset functions and the operator can use either one to perform the reset), as shown on the Points Schedule drawing.

3.2.9.5 System Enable and Loop Enable

3.2.9.5.1 Occupied Mode

Enable the supply fan (SYS-ENA) and command to run (SF-SS). Enable all control loops.

3.2.9.5.2 Unoccupied Mode

While the building temperature (BLDG-T) is above the low limit setpoint (BLDG-T-LL) disable all control loops and do not run the supply fan. When BLDG-T drops below BLDG-T-LL (with a 5 degrees F deadband), enable the supply fan (SYS-ENA) and command to run (SF-SS), enable the Supply Duct Static Pressure Control, Preheat Control loops. Disable the Minimum Outside Air Flow Control, Mixed Air Temperature Control, and Cooling Coil Control loops.

3.2.9.5.3 Warm Up/Cool Down

Enable the supply fan (SYS-ENA) and command to run (SF-SS). Disable the Minimum Outside Air Flow Control loop and enable all other control loops.

3.2.9.6 Fan Capacity Control

3.2.9.6.1 Supply Duct Static Pressure Control

When this loop is enabled, modulate the supply fan variable frequency drive unit to maintain the duct static pressure (SA-P) at setpoint (SA-P-SP) as shown, as measured by the duct static pressure tap and sensor as shown. When this loop is disabled, ensure the DDC Hardware capacity

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

modulation output to the VFD is zero percent.

3.2.9.7 Minimum Outside Air Flow Control

When this loop is enabled, modulate the minimum outside air damper to maintain the minimum OA volumetric flow (MINOA-F) at setpoint (MINOA-F-SP) as shown. When this loop is disabled, close the minimum outside air damper.

3.2.9.8 Mixed Air Temperature Control With Economizer

3.2.9.8.1 Enabled Loop

When this loop is enabled, and the Economizer is ON as determined by the Economizer Enable Logic, modulate the economizer outside air, relief, and return air dampers to maintain the mixed air temperature (MA-T) at setpoint (MA-T-SP) as shown.

3.2.9.8.2 Disabled Loop

When this loop is disabled, or the Economizer is OFF as determined by the Economizer Enable Logic, close the economizer outside air and relief air dampers, and open the return air damper.

3.2.9.8.3 Economizer Enable Logic

Ensure the economizer is ON when the outside air dry bulb temperature is between the high limit (ECO-HL-SP) and low limit (ECO-LL-SP) setpoints as shown. Otherwise the Economizer is OFF. Ensure ECO-HL-SP and ECO-LL-SP each have a 2 degrees F deadband.

3.2.9.9 Cooling Coil Control

When this loop is enabled, modulate the cooling coil valve to maintain the supply air temperature (SA-T) setpoint (SA-T-SP) as shown. When this loop is disabled, close the cooling coil valve.

3.2.9.10 Preheat Coil Control

When this loop is enabled, modulate the preheat coil valve to maintain the preheat coil discharge air temperature (PH-DA-T) at setpoint (PH-DA-T-SP) as shown. When this loop is disabled, close the preheat coil valve.

3.3 SEQUENCES OF OPERATION FOR TERMINAL UNITS

3.3.1 NOT USED

Safeties

This system has no safeties.

3.3.2 Zone Temperature Control - VAV Box with Reheat

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs and outputs as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control is proportional-integral (PI) control.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.3.2.1 Occupancy Modes

3.3.2.1.1 Occupied

Ensure the VAV box DDC Hardware is in the Occupied Mode when the local space occupancy input(s) (ZN-OCC) indicate that the space is occupied or when the input from the System Scheduler (SYS-OCC) is occupied.

3.3.2.1.2 Unoccupied

Ensure the VAV box DDC Hardware is in the Unoccupied Mode when the local space occupancy input(s) (ZN-OCC) indicate that the space is unoccupied and the input from the System Scheduler (SYS-OCC) is unoccupied.

3.3.2.2 Safeties

For VAV boxes with electric resistance heating elements, require proof of air flow before activating the heating elements.

3.3.2.3 Zone Temperature Control

- a. In the Occupied Mode, ensure the zone temperature setpoint (ZN-T-SP) is at the configured setpoint or at the occupant-adjustable setpoint via the wall-mounted thermostat, as shown.
- b. In the Unoccupied Mode, ensure the zone temperature setpoint (ZN-T-SP) is at the configured setpoint as shown.
- c. Modulate the VAV box damper to maintain VAV box supply air flow (VAV-SA-F) at setpoint as measured by a multi-point flow sensing element at the inlet to the VAV box. Perform sequencing as shown: Upon a rise in zone temperature above zone temperature setpoint (ZN-T-SP), subject to the zone temperature setpoint deadband as shown, adjust the airflow setpoint between minimum and maximum flow based on the difference between zone temperature and zone temperature setpoint as shown. Upon a fall in zone temperature below zone temperature setpoint, subject to the deadband as shown, maintain the airflow at a fixed air flow setpoint (with a setting independent of the cooling minimum air flow), and modulate the heating valve towards open or cycle the staged electric resistance heating coil(s) on in sequence.

3.3.3 NOT USED

3.3.4 NOT USED

3.3.5 Unit Heater and Cabinet Unit Heater

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs and outputs as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control is proportional-integral (PI) control.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.3.5.1 Off-Auto Switch

3.3.5.1.1 OFF

With the thermostat OFF-AUTO switch in the OFF position, stop the fan and close the heating control valve.

3.3.5.1.2 AUTO

With the thermostat OFF-AUTO switch in the AUTO position, control the unit in accordance with its Occupancy Mode.

3.3.5.2 Occupancy Modes

3.3.5.2.1 Occupied

Ensure the unit heater DDC Hardware is in the Occupied Mode when the local space occupancy input(s) indicate that the space is occupied or when the input from the System Scheduler is occupied.

3.3.5.2.2 Unoccupied

Ensure the unit heater DDC Hardware is in the Unoccupied Mode when the local space occupancy input(s) indicate that the space is unoccupied and when the input from the System Scheduler is unoccupied.

3.3.5.3 Safeties

Run the unit subject to the unit manufacturer's safeties.

3.3.5.4 Space Temperature Control

3.3.5.4.1 Occupied Mode

In the Occupied Mode, modulate the heating control valve and cycle the multi-speed fan to maintain space temperature at the configured setpoint or at the occupant-adjustable setpoint via the wall-mounted thermostat, as shown.

3.3.5.4.2 Unoccupied Mode

In the Unoccupied Mode, modulate the heating control valve and cycle the multi-speed fan to maintain space temperature at the configured setpoint as shown.

3.3.6 NOT USED

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs and outputs as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control is proportional-integral (PI) control.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.3.7 NOT USED

3.4 SEQUENCES OF OPERATION FOR HYDRONIC SYSTEMS

3.4.1 NOT USED

3.4.2 NOT USED

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs and outputs as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control is proportional-integral (PI) control.

3.4.2.1 System Enable and Loop Enable

- a. Monitor the enabled status of all systems served by this system. If one or more systems served by this system are enabled, enable this system (SYS-ENA). If no systems served by this system are enabled, disable this system.
- b. When this system is enabled (SYS-ENA) and the hot water pump is proofed on, enable the boiler control and hot water temperature control loops.

3.4.2.2 HAND-OFF-AUTO Switch

Provide hot water pump motor starter with an H-O-A switch:

3.4.2.2.1 HAND

With the H-O-A switch in HAND position, start the pump and run continuously.

3.4.2.2.2 OFF

With the H-O-A switch in OFF position, stop the pump.

3.4.2.2.3 AUTO

With the H-O-A switch in AUTO position, run the pump subject to the Hot Water Pump Start/Stop (HW-PMP-SS) command.

3.4.2.3 Proofs and Safeties

DDC Hardware must monitor all proofs and safeties.

3.4.2.3.1 Proofs

Hot water pump

3.4.2.3.2 Safeties

None

3.4.2.3.3 DDC Hardware Reset

Reset all proofs and safeties via a local binary push-button (RST-BUT) input to the DDC Hardware, via a remote command to the DDC Hardware via

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SNVT or both (where the Contractor provides both reset functions and the operator can use either one to perform the reset), as shown on the Points Schedule drawing.

3.4.2.4 Boiler Control

When this loop is enabled, turn the boiler on. When this loop is disabled, the boiler is turned off.

3.4.2.5 Hot Water Temperature Control

When this loop is enabled modulate the 3-way mixing valve to maintain hot water supply temperature (HWS-T) at setpoint (HWS-T-SP). The Hot Water Supply Temperature Setpoint (HWS-T-SP) must be determined from a linear reset schedule as shown. When this loop is disabled, the valve is in its normal (failsafe) position.

3.4.3 NOT USED

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs and outputs as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control is proportional-integral (PI) control.

3.4.4 Hydronic Secondary with Variable Speed Pump

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs and outputs as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control is proportional-integral (PI) control.

3.4.4.1 System Enable and Loop Enable:

- a. Monitor the enabled status of all systems served by this system. If one or more systems served by this system are enabled, enable this system (SYS-ENA). If all systems served by this system are not enabled, do not enable this system.
- b. When this system is enabled (SYS-ENA) the Pressure Control loop must be enabled.

3.4.4.2 HAND-OFF-AUTO Switch

Provide hot water pump variable frequency drive (VFD) unit with an integral H-O-A switch:

3.4.4.2.1 HAND

With the H-O-A switch in HAND position, the pump starts and runs continuously. Ensure pump speed is under manual-operator control.

3.4.4.2.2 OFF

With the H-O-A switch in OFF position, the pump stops.

3.4.4.2.3 AUTO

With the H-O-A switch in AUTO position, run the pump subject to the Hot Water Pump Start/Stop (HW-PMP-SS) command and ensure pump speed is under

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

control of the DDC system.

3.4.4.3 Proofs and Safeties

DDC Hardware must monitor all proofs and safeties.

3.4.4.3.1 Proofs

None

3.4.4.3.2 Safeties

None

3.4.4.3.3 DDC Hardware Reset

Reset all proofs and safeties via a local binary push-button (RST-BUT) input to the DDC Hardware, via a remote command to the DDC Hardware via SNVT or both (where the Contractor provides both reset functions and the operator can use either one to perform the reset), as shown on the Points Schedule drawing.

3.4.4.4 Pressure Control

When this loop is enabled modulate the pump variable frequency drive unit to maintain the pipe system pressure at setpoint as shown, as measured by the differential pressure tap and sensor as shown. When this loop is disabled, ensure the DDC Hardware capacity modulation output to the VFD is zero percent.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 21 23

HYDRONIC PUMPS

05/25

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 B1.1 (2024) Unified Inch Screw Threads (UN, UNR, and UNJ Thread Form)

ASME B16.1 (2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A307 (2023) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

HYDRAULIC INSTITUTE (HI)

HI 1.3 (2013) Rotodynamic (Centrifugal) Pump Applications

HI 9.6.4 (2009) Rotodynamic Pumps for Vibration Analysis and Allowable Values

HI ANSI/HI 9.6.3 (2024) Rotodynamic Pumps - Guideline for Operating Regions - B120

HI ANSI/HI 14.1-14.2 (2019) Rotodynamic Pumps for Nomenclature and Definitions

HI ANSI/HI 14.6 (2011) Rotodynamic Pumps for Hydraulic Performance Acceptance Tests - A136

MASTER PAINTERS INSTITUTE (MPI)

MPI 23 (2015) Primer, Metal, Surface Tolerant

MPI 76 (2016) Primer, Alkyd, Quick Dry, for Metal

MPI 94 (2016) Alkyd, Exterior, Semi-Gloss (MPI Gloss Level 5)

MPI 141 (2016) Latex, Interior, High Performance

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Architectural, Semi-Gloss (MPI Gloss Level
5)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2021) Motors and Generators

NEMA Z535.4 (2023) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2023; ERTA 1 2024; TIA 24-1; TIA 25-2)
National Electrical Code

NSF INTERNATIONAL (NSF)

NSF 372 (2022) Drinking Water System Components -
Lead Content

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 431.464 Test Procedure for the Measurement of
Energy Efficiency, Energy Consumption, and
Other Performance Factors of Pumps

10 CFR 431.465 Circulator Pumps Energy Conservation
Standards and the Compliance Dates

29 CFR 1910.219 Mechanical Power Transmission Apparatus

UL SOLUTIONS (UL)

UL 778 (2016; Reprint Jul 2024) UL Standard for
Safety Motor-Operated Water Pumps

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. Submittals not having a "G" or "S" classification are 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

System Coordination;

SD-03 Product Data

Base-Mounted, Close Coupled, End Suction Pumps;

Framed Instructions;

SD-06 Test Reports

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Factory Tests

Field Quality Control

Pump Motor/Alignment Report;

SD-07 Certificates

Manufacturer's Representative

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals;

Training;

1.3 QUALITY ASSURANCE

1.3.1 Manufacturer Services

Provide the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative must supervise the installation, adjustment, testing of the equipment, and conduct training.

Submit the names and qualifications of the manufacturer's representative and training engineers and written certification from the manufacturer that the representative and trainers are technically qualified.

1.3.2 Standard Products

Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate equipment that has been in satisfactory HVAC operation at least 2 years prior to issuance of this solicitation. Support equipment with a service organization that is reasonably convenient to the jobsite. Pumps and motors of the same types must each be the product of one manufacturer.

1.3.3 Conformance with Agency Requirements

Where materials or equipment are specified to be an approved type, attach the seal or label of approval from a nationally recognized testing agency, adequately equipped and competent to perform such services. A written certificate from the testing agency must accompany the materials or equipment and be submitted stating that the items have been tested and that they conform to the applicable requirements of the specifications and to the standards listed herein. The certificate must indicate the methods of testing used by the testing agency. In lieu of a certificate from a testing agency, published catalog specification data, accompanied by the manufacturer's certified statement to the effect that the items are in accordance with the applicable requirements of the specifications and the referenced standards, will be considered and may be acceptable as evidence that the items conform with agency requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect equipment, delivered and designated for storage, from the weather,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Hydronic pumps used for heating and air conditioning applications are defined by the type of impeller, number of impellers, type of casing, method of connection to the driver, and mounting position. Provide centrifugal water pumps of the types indicated and specified. Use an electric motor driving unit for each pump as indicated and specified.

2.1.1 Selection Criteria

Select pumps at a point within the maximum efficiency for a given impeller casing combination. Deviations within 3 percent of maximum efficiency are permissible, provided the lesser efficiency is not less than the scheduled efficiency in the construction design documents. Pumps having impeller diameters larger or smaller than manufacturer's published maximum and minimum impeller diameters for a given impeller casing combination will be rejected. Pump performance data, as shown in performance curves, must be based on factory tests using precision instrumentation and exacting procedures as detailed in HI ANSI/HI 14.6. Pump and motor must meet minimum Department of Energy requirements and must have a maximum Pump Efficiency Index (PEI) of 1.0 in accordance with 10 CFR 431.464 and 10 CFR 431.465.

2.1.2 System Coordination

Submit drawings containing complete wiring and piping schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Show the proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation. Provide a complete listing of equipment, materials and miscellaneous components including mechanical seals, bearings, and couplings.

2.1.3 Safety Requirements

Fully enclose or guard couplings, projecting set-screws, keys, and other rotating parts, that pose an entangling hazards.

2.2 MATERIALS AND EQUIPMENT

2.2.1 Nameplates

Securely affix a standard nameplate to pumps and motors in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, for each pump show the capacity in gpm at rated speed in rpm and total head in feet of water. For each electric motor show at least the minimum information required by NEMA MG 1. Show such other information as the manufacturer may consider necessary to complete identification on the nameplate. Pumps must be listed and labeled by UL, and comply with UL 778 for pumps not using universal motors rated more than 250 volts such as circulating pumps.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.2 Framed Instructions

Submit proposed diagrams, instructions, and other sheets, prior to posting. Post approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping valves, and control sequence, framed under glass or in approved laminated plastic, where directed. Provide condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. Post the framed instructions before acceptance testing of the systems.

2.2.3 Pump Characteristic

Construct hydronic water pumps in accordance with HI ANSI/HI 14.1-14.2. The pumps must be capable of discharging quantities at total discharge heads measured at the discharge flange, between the following limits:

Operate pumps at optimum efficiencies to produce the most economical pumping system under the conditions encountered. Operate pumps at specified system fluid temperatures without vapor binding and cavitation. Select pumps to operate within the Preferred Operating Region (POR) related to specific speed in accordance with HI ANSI/HI 9.6.3.

2.2.4 Pump Drivers

Provide electric motors as indicated for each pump and in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2.5 Equipment Data

Submit manufacturer's descriptive data and technical literature, performance charts and curves for all impeller sizes for a given casing, catalog cuts, and installation instructions. Provide spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 3 months prior to the date of beneficial occupancy. Include a complete list of parts and supplies, with current unit prices and local source of supply with contact information.

Submit catalog information, certified pumps curves, rated capacities, final impeller dimensions, and accessories provided for the product indicated. Indicate operating point of each pump on curves. Furnish pump curves for each pump and combination of pumps designed to operate in parallel. The pump curve must show as a minimum; bhp, flow, total dynamic head, efficiency, NPSH, impeller diameter and system curve (individually and in combination for each pump operating in a parallel application). Select pumps operating in parallel operation to cross the system curve while operating in parallel and during single pump operation.

2.3 HYDRONIC PUMPS

2.3.1 NOT USED

- a. The three piece pump must be composed of three separable components a motor, bearing assembly, and cast iron certified in accordance with NSF 372 pump end (wet end). The motor shaft must be connected to the pump shaft via a replaceable flexible coupler.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- b. Wet rotor circulator for potable water service must be lead content certified in accordance with NSF 372.

2.3.2 NOT USED

2.3.3 NOT USED

2.3.4 NOT USED

2.3.4.1 Motor

Electric Motors must meet NEMA MG 1 and be the horsepower, speed, and voltage indicated. Motor enclosure must be open drip proof, . Motor must have heavy duty grease lubricated ball bearings completely adequate for the maximum load for which the motor is designed. Motor must be non-overloading at any point on the pump curve and premium efficiency.

2.3.5 Base-Mounted, Close Coupled, End Suction Pumps

Provide pumps with capacities as indicated. Pump must be base mounted, close coupled, single stage, end suction design capable of being serviced without disturbing piping connections.

2.3.5.1 Casing

Provide pump volute of Class 30 cast iron suitable for 175 psig working pressure. Include vent, drain and gauge taps.

2.3.5.2 Seal Assembly

Seal off the liquid cavity at the motor shaft by an internally flushed mechanical seal or a positive pressure external seal flushing line with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225 degrees F. A replaceable shaft sleeve of bronze alloy must completely cover the wetted area under the seal.

2.3.5.3 Impeller

Provide cast bronze or 304 stainless steel impeller, enclosed type, hydraulically and dynamically balanced to HI 9.6.4 balance grade G6.3, keyed to shaft and secured by a locking cap screw.

2.3.5.4 Motor

Electric Motors must comply with NEMA MG 1 and be the horsepower, and voltage indicated. Motor enclosure must be open drip proof, . Provide with heavy duty grease lubricated ball bearings completely adequate for the maximum load for which the motor and pump impeller is designed. Motor must be non-overloading at any point on the pump curve and premium efficiency. Totally enclosed fan cooled motor efficiencies must be as shown in NEMA MG 1.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.3.6 NOT USED

2.3.7 NOT USED

2.3.8 Cooling Coil Condensate Pump Units

Provide pumps with capacities as indicated. Cooling Coil Condensate Pump Unit must be a packaged unit including a corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory installed check valve. Provide hard wired power connection.

2.3.8.1 Motor

Electric motor must comply with NEMA MG 1 and be the size, and voltage indicated.

2.4 ELECTRICAL WORK

Provide electrical motor driven equipment specified herein complete with motors, motor starters, and controls. Provide electric equipment and wiring in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical characteristics must be as indicated. Provide motor starters complete with properly sized thermal overload protection in each phase and other appurtenances necessary for the motor control specified. Each motor must be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage and frequency. Manual or automatic control and protective or signal devices required for the operation herein specified and any control wiring required for controls and devices but not indicated must be provided under this section of the specifications.

2.5 ELECTRICAL EQUIPMENT

Provide electrical equipment in conformance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide electrical motor driven equipment herein specified complete with motors, motor starters, and controls. Motor controls, equipment, and wiring must be in accordance with NFPA 70.

2.5.1 Electric Motors

Drive each electric motor-driven pump by a continuous-duty electric motor with enclosure type for specific service as defined in paragraph HYDRONIC PUMPS. Motor must have a 1.5 service factor. Provide electronically commutated motors having normal-starting-torque and low-starting-current characteristics, and of sufficient size so that the nameplate horsepower rating must not be exceeded throughout the entire published pump characteristic curve. Integral size motors must be the premium efficiency type in accordance with NEMA MG 1. Motor bearings must provide smooth operations under the conditions encountered for the life of the motor. Provide adequate thrust bearing in the motor to carry the weight of all rotating parts plus the hydraulic thrust and be capable of withstanding upthrust imposed during pump starting and under variable pumping head conditions specified. Motors must be rated 480 volts, 3 phase, 60 Hz and such rating must be stamped on the nameplate. Provide motors in conformance with NEMA MG 1.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.5.2 Control Equipment

Automatically controlled pumps must have three-position "MANUAL-OFF-AUTOMATIC" selector switch in cover. Provide additional controls or protective devices as indicated.

2.5.3 Variable Speed Control

2.5.3.1 Adjustable Speed Drive

The variable speed motor controllers must be in accordance with Section 26 29 23 ADJUSTABLE SPEED DRIVE SYSTEMS UNDER 600 VOLTS.

2.6 PACKAGED PUMP SYSTEM

Provide packaged pump system which includes pumps, variable frequency drives, piping, valves, complete wiring and controls systems, and accessories as specified.

2.6.1 Pumps

Pumps must be base-mounted, close couple, end suction. Indicate pump capacities on the drawings.

2.6.2 Piping and Appurtenances

Ship the pump package pump system with all internal piping installed. The piping includes pumps, suction piping, discharge piping, pressure sensing, and gauge piping. When flanged field connections are required, module piping must terminate with a mechanical grooved type flange to facilitate alignment. The piping must consist of fabricated welded steel headers with cast iron fittings in and out of pumps. Provide an ANSI flange at the suction and discharge connection for the system, with same pressure class as the piping system, but not less than 150 psig. Provide butterfly valves on the suction and discharge of each pump. Support piping independently of pump connections. Pipe all control sensing lines and gauge connections with shut-off valves. Provide pressure gauges mounted on a panel for indication of suction and discharge pressure. Install a check valve on the discharge of each pump. Install a suction strainer on the suction of each pump. The strainer must be of the type mounted directly to the pump suction or inline "Y" type. Components must be in accordance with Section 23 05 15 COMMON PIPING FOR HVAC.

2.6.3 Structural Steel Base

Mount pumps on the structural steel base free of distortion caused by flexing of the system piping by providing flexible coupling on pump suction and discharge connection.

2.6.4 Variable Speed Control

2.6.4.1 Adjustable speed Drive Systems

The variable speed motor controllers must be in accordance with Section 26 29 23 ADJUSTABLE SPEED DRIVE SYSTEMS UNDER 600 VOLTS.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.6.4.2 Motor-Drive Unit

Combination motor and variable speed motor controller provided by the pump manufacturer. Include provisions in the motor-drive unit disconnect the drive and motor independently. Provide the motor-drive unit with a menu-driven graphical keypad display for drive control and provide a rated enclosure with an environmental protection rating of NEMA4/IP55. The drive unit must integrate into the building automation system in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC or Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS and allow control by DDC system control signal. The motor-drive unit must be capable of multi-pump control up to four pumps in parallel.

2.6.4.3 Electronically Commutated Motor

Drive the pump by an electronically commutated electrical motor (ECM) with permanent magnet rotor. The rotor magnets must be time stable, non-toxic ceramic magnets. Drive the electronically commutated motor by a frequency converter with an integrated PFC filter.

2.6.5 Electrical

Completely wire the pump package, in accordance with the NEC, from the main service disconnect to all the associated equipment. Include the following equipment: main service disconnect, variable frequency drives, pump controller, and transformer. Provide all equipment with overcurrent protection where required by NEC.

2.6.6 Controls

2.6.6.1 Controller

Control the packaged pump system by a direct digital controller, microcomputer based and must hold its keep memory in the event of power failure. Store in non-volatile memory on-line programmable data entries, such as set point. The controller must be capable of receiving up to ten differential input analog signals and comparing them to their individual set points. Utilize the analog signal that has deviated the greatest amount from its setpoint. This selected signal and its associated setpoint must be used as the command feedback inputs to perform a closed-loop-control function. The analog input signal must be the feedback or process and the setpoint must be the command. Control loop function must have the capability of performing a self-tuning algorithm to maintain the process variable at setpoint regardless of process loading conditions. The control cubicle must be single compartment construction. Controls must be 115 volt including run light and "Hand-Off-Automatic" switch for each pump, power on light, lead pump selector switch for manual alternation or automatic through the DDC system, pump sequencing logic, and necessary interface controls for variable frequency drives. Provide a control panel in compliance with the requirements of Underwriters Laboratories. All wiring and electrical construction within the panel must conform to Underwriters Laboratories' requirements. The controller must be designed for remote mounting.

2.6.6.2 Software

Provide the controller with off-line or on-line diagnostics software. The on-line diagnostics must perform such functions as "alarm definitions

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

displayed". It must have as an integral part of its hardware designed a watchdog timer reset function and must be powered by 115 VAC, 60 HZ. The incoming power and input/output circuitry design must facilitate rejection of EMI (electromagnetic interferences) and RFI (radio-frequency interferences).

2.6.6.3 Integration

The pump package must be fully coordinated with and integrated into the building automation system in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC or Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. The following inputs and outputs must be interfaced between the pump system controller and the DDC system.

- a. Pump System Controller input from the DDC system.
 - (1) Secondary Pump System Start/Stop digital input.
 - (2) Pump 1 / 2 Lead/Lag.
 - (3) Primary Pump 1 Start/Stop.
 - (4) Primary Pump 2 Start/Stop.
- b. Pump System Controller Outputs to the DDC system.
 - (1) Secondary Pump #1 on/off status digital output.
 - (2) Secondary Pump #2 on/off status digital output.
 - (3) Pump fail to start - digital output (alarm).
 - (4) Secondary Pump #1 speed indication (4-20 ma).
 - (5) Secondary Pump #2 speed indication (4-20 ma).
 - (6) System Flow (4-20 ma).
 - (7) Primary Pump 1 Flow status digital output.
 - (8) Primary Pump 2 Flow status digital output.

2.6.6.4 Sequence

The pump system controller must receive a run enable from the DDC system and control the VFD to maintain the control point at the setpoint. Provide optimized control of the pumping system through the controller to provide the "best efficiency" of the pumping system. Primary pumps must start and stop based on command from the DDC System.

2.6.7 Testing

Hydrostatically test the entire module piping assembly at same pressure as the piping system but not less than 150 psig. Repair any leaks found and retest before module shipment.

Factory test the packaged pumping system at full flow conditions prior to shipment. Testing must include operation of the pumps, motors, variable

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

frequency drives, controls and accessories. Certified test results to be provided to the Owner. Notify the Engineer two weeks prior to factory test so that they may witness the same.

2.7 EQUIPMENT APPURTENANCES

2.7.1 Attachments

Furnish all necessary bolts, nuts, washers, bolt sleeves, and other types of attachments with the equipment for the installation of the equipment. Bolts must be in accordance with ASTM A307 and hexagonal nuts are to be of the same quality as the bolts used. Threads must be clean-cut in accordance with ASME B1.1. Bolts, nuts, and washers specified to be galvanized or not otherwise indicated or specified, must be zinc coated after being threaded, by the hot-dip process in accordance with ASTM A123/A123M as appropriate. Bolts, nuts, and washers specified or indicated to be stainless steel must be Type 316.

2.7.2 Equipment Guards

Provide equipment driven by open shafts, belts, chains, or gears with all-metal guards enclosing the drive mechanism. Secure guards in position with steel braces or straps that permit easy removal for servicing the equipment. Coupler guards must comply with current national safety standards including 29 CFR 1910.219 and NEMA Z535.4. Provide guards with gaps no greater than 0.250 inches, safety orange in color, and have an NEMA Z535.4 compliant warning label.

2.7.3 Tools

Furnish a complete set of all special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment. Special tools are considered to be those tools which, because of their limited use are not normally available, but which are necessary for the particular equipment. Special tools must be high-grade, smooth, forged, alloy, tool steel. Furnish one pressure grease gun for each type of grease required. Deliver all tools at the same time as the equipment to which they pertain. Properly store and safeguard such tools until completion of the work, at which time deliver them to the Contracting Officer.

2.7.4 Pump Suction Diffuser/Guide

Provide a cast iron or ductile iron pump suction diffuser/guide with flanges confirming to ASME B16.1, Class 125. The pump suction guide must provide inlet condition enhancement to the pump by guide vanes.

2.8 FINISHES

All motors, pump casings, and similar parts of equipment must be thoroughly cleaned, primed, and given two finish coats of paint at the factory in accordance with the recommendations of the manufacturer. Give ferrous surfaces not to be painted a shop coat of grease or other suitable rust-resistant coating.

2.9 FACTORY TESTS

Pumps must be tested by the manufacturer or a nationally recognized testing agency in compliance with HI 1.3. Submit certified test results.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

Install each pump and motor in accordance with the written instructions of the manufacturer. Provide access space around the device for servicing no less than the minimum recommended by the manufacturer. All recommendations in the written instructions of the manufacturer are mandatory requirements.

3.2.1 Base Mounted, Long-Coupled Pumps

Set the pump baseplate as follows.

- a. Place two sets of shims or wedges for each foundation bolt. Lower baseplate onto foundation bolts and level baseplate both lengthwise and across by adding or removing shims or mount wedges. A maximum difference of 0.125 inches lengthwise and 0.059 inches across is allowable.
- b. Mount pump and driver on baseplate if not already mounted at factory. Pump and driver shafts must have an initial cold (pump and driver at ambient temperature) alignment check and final hot (pump and driver at operating temperature) alignment check. Perform cold alignment check before baseplate is grouted, after baseplate is grouted, and after piping is connected. Perform final alignment check when pump and driver are at operating temperature. Move or shim only the driver to make adjustments to prevent strain on the piping installations. Initial alignment may be performed with scales, straight edges and calipers. Final alignment must be done with dial gauges or laser alignment devices. Final alignment misalignment may not exceed coupling manufacturer's maximum parallel and angular misalignment values. When using variable frequency drives, reduce the manufacturer's misalignment values by 50 percent. Remove flexible coupling when performing alignment.
- c. Support the connecting piping to ensure that there are no piping loads at the pump flange connections and connecting piping is not forced into position. Use concrete for equipment foundations in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. Provide concrete foundations that are integral with and of the same class as that of the building floor unless otherwise indicated. Use concrete having a compressive strength of at least 2,500 psi in foundations that are entirely separated from the surrounding floor. Install a pre-molded filler strip between the foundation and floor slab as shown. Furnish foundation bolts, as required, for proper positioning during the placement of the concrete.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2.2 NOT USED

3.3 FIELD QUALITY CONTROL

After installation of the pumping units and appurtenances, including coupling guard, is complete, carry out operating tests to assure that the pumping installation operates properly. Give each pumping unit a running field test in the presence of the Contracting Officer for a minimum of 2 hours. Operate each pumping unit at its rated capacity or such other point on its head-capacity curve selected by the Contracting Officer. Provide an accurate and acceptable method of measuring the discharge flow. Tests must assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly. If any deficiencies are revealed during any tests, correct such deficiencies and reconduct the tests.

Provide a pump start-up report and 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, upon completion and testing of the installed system. Each test report must indicate the final position of controls.

3.4 FIELD PAINTING

Do not paint stainless steel, galvanized steel, and nonferrous surfaces.

3.4.1 Touch-up painting

Factory painted items requiring touching up in the field must be thoroughly cleaned of all foreign material, and primed and top coated with the manufacturer's standard factory finish.

3.4.2 Exposed Ferrous Surfaces

Paint exposed ferrous surfaces with two coats of enamel paint in accordance with Section 09 90 00 PAINTINGS AND COATING. For interior ferrous metal, apply High Performance Latex System. Prime in accordance with MPI 76 and apply intermediate and topcoat in accordance with MPI 141. For exterior ferrous metal, apply Alkyd system. Primer per MPI 23 and apply intermediate and topcoat per MPI 94.

3.5 CLOSEOUT ACTIVITIES

3.5.1 Operation and Maintenance Manuals

Submit one complete set at the time the tests procedure is submitted; remaining sets before the contract is completed. Permanently bind each in a hard cover. Inscribe the following identification on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the building, name of the Contractor, and contract number. Place flysheets before instructions covering each subject. Use 8-1/2 by 11 inches paper for instruction sheets, with large sheets of drawings folded in.

Include, but do not limit to, the following in the Instructions:

- a. System layout showing piping, valves, and controls.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- b. Approved wiring and control diagrams including variable frequency drives.
- c. A control sequence describing startup, operation, and shutdown.
- d. Operating and maintenance instructions for each piece of equipment, including task list for routine maintenance, routine inspections, intermediate inspections, and annual inspections; lubrication instructions; and troubleshooting guide.
- e. Manufacturer's bulletins, cuts, and descriptive data; and parts list and recommended spare parts.

3.5.2 Training

Upon completion of the work, and at a time designated by the Contracting Officer, provide the services of one or more competent engineers for a training period of not less than 4 hours to instruct a representative of the Government in the contents of the operation and maintenance manuals for the equipment furnished under these specifications. These field instructions must cover all the items contained in the bound instructions. Submit the training course curriculum and training instructions 14 days prior to the start of training.

3.5.3 Pump Motor/Alignment Report

Provide a pump motor/alignment report for base mounted pumps showing alignment of the motor and driver with initial cold alignment check prior to grouting, after grouting, and after piping connection, and final hot alignment check. Include in the alignment reports the parallel and angular alignment values and manufacturer's maximum allowable values.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 30 00

HVAC AIR DISTRIBUTION 02/25

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
AMCA 511	(2010; R 2016) Certified Ratings Program for Air Control Devices

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

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 880 I-P	(2011) Performance Rating of Air Terminals
AHRI 885	(2008; Addendum 2011) Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
AHRI DCAACP	(Online) Directory of Certified Applied Air-Conditioning Products

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(2015) Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	(2014; R 2020) Load Ratings and Fatigue Life for Roller Bearings

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

ASHRAE 52.2	(2017; Addenda B 2020; Errata 1 2020; Addenda C 2022; Errata 2 2024; Addenda D 2025) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 62.1	(2016) Ventilation for Acceptable Indoor Air Quality
ASHRAE 70	(2023) Method of Testing the Performance of Air Outlets and Inlets
ASHRAE 90.1 - IP	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A240/A240M	(2025a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2022a) 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 B152/B152M	(2019) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B209/B209M	(2021a) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B280	(2023) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B766	(2023) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM C534/C534M	(2025) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASTM C553	(2024) 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 2019) 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

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
--------------------	--

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60034-30-1	(2014) Rotating Electrical Machines – Part 30-1: Efficiency Classes of Line Operated AC Motors (IE Code)
----------------	--

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 21940-11	(2016) Mechanical vibration -- Rotor balancing -- Part 11: Procedures and Tolerances for Rotors with Rigid Behavior
--------------	---

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
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 10009	(2022) Energy Management Guide for Selection and Use of Single-Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 1 2024; TIA 24-1; TIA 25-2) National Electrical Code
NFPA 80	(2025) Standard for Fire Doors and Other Opening Protectives

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

NFPA 90A (2024) Standard for the Installation of
Air Conditioning and Ventilating Systems

NFPA 90B (2024) Standard for the Installation of
Warm Air Heating and Air Conditioning
Systems

NFPA 701 (2023; ERTA 1 2023) Standard Methods of
Fire Tests for Flame Propagation of
Textiles and Films

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

ANSI/SMACNA 006 (2020) HVAC Duct Construction Standards
Metal and Flexible

SMACNA 1819 (2022) Fire, Smoke and Radiation Damper
Installation Guide for HVAC Systems, 5th
Edition

SMACNA 1884 (2003) Fibrous Glass Duct Construction
Standards, 7th Edition

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2022) Adhesive and Sealant Applications

U.S. DEPARTMENT OF ENERGY FEDERAL ENERGY MANAGEMENT PROGRAM (FEMP)

PL-109-58 (1992; R 2005) Energy Efficient Procurement
Requirements

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82 Protection of Stratospheric Ozone

UL SOLUTIONS (UL)

UL 6 (2022) 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 555 (2006; Reprint Aug 2016) UL Standard for
Safety Fire Dampers

UL 555S (2014; Reprint Oct 2020) UL Standard for
Safety Smoke Dampers

UL 586 (2009; Reprint Sep 2022) UL Standard for
Safety High-Efficiency Particulate, Air
Filter Units

UL 705 (2017; Reprint Sep 2024) UL Standard for
Safety Power Ventilators

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 Fire Resistance	(2014) Fire Resistance 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.

1.2.1.2 Diagrams

Submit proposed diagrams, at least 2 weeks prior to start of related testing. provide neat mechanical drawings provided with extruded aluminum frame under 1/8-inch glass or laminated plastic, system diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system. After approval, post these items where directed.

1.2.2 Service Labeling

1.2.2.1 Equipment Labeling

Label equipment as indicated below 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 - 1, 2, 3, 5

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SERVICE	LABEL AND TAG DESIGNATION
Control and instrument air	CONTROL AND INSTR.
Exhaust Fan Number	EF - 1
VAV Box Number	VAV - 1

1.2.2.2 Pipe Labeling

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. Color coding of all piping systems must be in accordance with ASME A13.1. 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.
- e.

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

1.2.2.3 Ductwork Labeling

Label ductwork with 2 inch lettering indicating the type of ductwork, associated air handling device and arrow indicating direction of airflow. Coordinate ductwork labeling with any duct insulation and painting requirements to assure labeling is visible on final installation. Duct labels are to be black text on white background, produced by either paint/stenciling or made of self-sticking, plastic film designed for permanent installation. Locations of ductwork labels are to be in accordance with the following:

- a. Each point of entry and exit of ductwork passing through walls.
- b. In congested or hidden areas and at all access panels at each point required to clarify service.
- c. In long straight runs, locate labels at distances within eyesight of each other not to exceed 75 feet.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S"

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are 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;

SD-03 Product Data

Metallic Flexible Duct

Insulated Nonmetallic Flexible Duct Runouts

Pre Manufactured Double Wall Ductwork

Fabric Ductwork

Duct Connectors

Duct Access Doors;

Fire Dampers;

Manual Balancing Dampers;

Gravity Backdraft and Relief Dampers;

Automatic Smoke-Fire Dampers;

Automatic Smoke Dampers;

Sound Attenuation Equipment

Acoustical Duct Liner

Diffusers

Registers and Grilles

Louvers

Air Vents, Penthouses, and Goosenecks

Centrifugal Fans

In-Line Centrifugal Fans

Axial Flow Fans

Propeller Type Sidewall Fans

Centrifugal Type Power Wall Ventilators

Centrifugal Type Power Roof Ventilators

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Propeller Type Power Roof Ventilators

Air-Curtain Fans

Ceiling Exhaust Fans

PL-109-58 label for ceiling exhaust fan product; S

Air Handling Units;

Room Fan-Coil Units;

Constant Volume, Single Duct Terminal Units;

Variable Volume, Single Duct Terminal Units;

Variable Volume, Single Duct, Fan-Powered Terminal Units;

Dual Duct Terminal Units;

Reheat Units;

Unit Ventilators

Energy Recovery Devices;

Hydronic Modular Panels;

Prefabricated Radiant-Heating Electric Panels;

Test Procedures

Diagrams;

Indoor Air Quality for Duct Sealants; S

SD-06 Test Reports

Performance Tests;

Damper Acceptance Test;

SD-07 Certificates

Bolts

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;

Fire Dampers;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Manual Balancing Dampers;
Automatic Smoke-Fire Dampers;
Automatic Smoke Dampers;
Centrifugal Fans;
In-Line Centrifugal Fans;
Axial Flow Fans;
Propeller Type Sidewall Fans;
Centrifugal Type Power Wall Ventilators;
Centrifugal Type Power Roof Ventilators;
Propeller Type Power Roof Ventilators;
Air-Curtain Fans;
Ceiling Exhaust Fans;
Air Handling Units;
Room Fan-Coil Units;
Constant Volume, Single Duct Terminal Units;
Variable Volume, Single Duct Terminal Units;
Variable Volume, Single Duct, Fan-Powered Terminal Units;
Dual Duct Terminal Units;
Reheat Units;
Unit Ventilators;
Energy Recovery Devices;
Hydronic Modular Panels;
Prefabricated Radiant-Heating Electric Panels;

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 STANDARD PRODUCTS

Except for the fabricated duct, plenums and casings specified in paragraphs "Metal Ductwork" and "Plenums and Casings for Field-Fabricated Units", provide components and equipment that are standard products of manufacturers regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. This requirement applies to all equipment, including diffusers, registers, fire dampers, and balancing dampers.

- a. Standard products are defined as components and equipment that have been in satisfactory commercial or industrial use in similar applications of similar size for at least two years before bid opening.
- b. Prior to this two year period, these standard products must have been sold on the commercial market using advertisements in manufacturers' catalogs or brochures. These manufacturers' catalogs, or brochures must have been copyrighted documents or have been identified with a manufacturer's document number.
- c. Provide equipment items that are supported by a service organization.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

2.3 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.

2.4 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. The requirements for catwalks, operating platforms, ladders, and guardrails are specified in Section 08 31 00 ACCESS DOORS AND PANELS.

2.5 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 00 INTERIOR 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, including motors that are part of a system, in accordance with NEMA MG 10009 and NEMA MG 1. Provide premium efficiency type for alternating current motors in accordance with NEMA MG 1.
- c. For polyphase motors, provide either ECM or squirrel-cage medium induction motors. Utilize the best equipment for the given mechanical equipment characteristics, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1 or NEMA MG 10009. 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

2.5.1 Electronically Commutated Motors

Provide ECM Motors of a sufficient size for the duty to be performed while not exceeding the full-load rating when the driven equipment is operating at specified capacity under the most severe loading conditions.

2.5.1.1 Design Requirements

- a. Provide Electronically Commutated Motors (ECM) designed as a DC brushless motor for variable speed or constant speed motor control. ECM design must allow for factory setting of the unit's fan flow. ECM must maintain respective constant fan speed at all set points regardless of external pressures that are within design ranges. Motor must be permanently lubricated with ball bearings with an L-10 rated life of not less than standards in accordance with ABMA 9 or ABMA 11.
- b. ECM will be complete with and be operated by a single-phase or three-phase integrated controller/inverter. AC power will be rectified, filtered and then converted to DC power. This will ensure variable speed operation at DC power.
- c. ECM controller must be capable of accepting a 0-10VDC or a 4-20mA signal for manual/automatic control.
- d. Ensure efficiency is a minimum of 70 percent over the motors entire operating range.

2.5.1.2 Electrically Driven Equipment

When electrically driven equipment differs from that indicated, make adjustments to the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment installed, at no additional cost to the Government. Provide control and protective devices in accordance with NFPA 70 requirements.

2.5.1.3 Voltage Ratings

Provide at a minimum, motors with the following voltage ratings:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

MOTOR SIZE		FED FROM POWER SOURCE	MOTOR VOLTAGE RATING
MOTOR TYPE	HORSE POWER		
Fractional horsepower, single-phase	3/4 and smaller	120/208-volt, 120/240-volt, 480/277-volt, 3-phase, 4-wire	115-volt, 200-volt, 230-volt, 277-volt 1-phase 50/60-hertz
Integer horsepower, single-phase	1	120/208-volt, 120/240-volt, 277/480-volt, 3-phase, 4-wire	115-volt, 200-volt, 230-volt, 277-volt 1-phase 50/60-hertz
Integer horsepower, single-phase	2 and 3	120/208-volt, 120/240-volt, 3-phase, 4-wire	200-volt, 230-volt, 1-phase 50/60-hertz
Integer horsepower, three-phase	1 thru 5	120/208-volt, 120/240-volt, 277/480-volt, 3-phase, 4-wire	200-volt, 230-volt, 460-volt, 3-phase 50/60-hertz
Integer horsepower, three-phase	7.5 and above	277/480-volt, 3-phase, 4-wire	460-volt, 3-phase 50/60-hertz

2.5.1.4 Temperature Rating and Insulation

Provide motors designed for continuous operation at the rated full load in an ambient temperature of 40 degrees C, 104 degrees F, with an insulation level of at least Class B.

2.5.1.5 Motor Enclosures

2.5.1.5.1 Indoor Type Enclosures

- a. For motors installed in indoor, clean, dry, non-hazardous locations, provide the following: Open-type drip-proof enclosures.
- b. For motors installed in indoor, wet, non-hazardous locations, provide the following: Open splash-proof enclosures.
- c. For motors installed in indoor, non-hazardous locations where it is necessary to protect the motor from dirt, moisture, chemical fumes, or other harmful ingredients in the surrounding atmosphere, provide either of the following type of enclosure: Totally enclosed fan-cooled enclosures for exterior cooling by means of a fan or fans integral with the machine.

2.6 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

equipment manufacturer and located by means of suitable templates.
Installation of anchor bolts must not degrade the surrounding concrete.

2.7 SEISMIC ANCHORAGE

Provide seismic bracing for HVAC systems components in accordance with
23 05 48.19 SEISMIC BRACING FOR MECHANICAL SYSTEMS

2.8 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing. Paint in accordance with Section 09 96 00 HIGH-PERFORMANCE COATINGS.

2.9 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.

2.10 CORROSION PROTECTION FOR COASTAL INSTALLATIONS

Provide air handling coils with aluminum fins on copper tubes or micro channel coils or otherwise custom treated for corrosion protection. Coils on all outdoor equipment of 10 ton capacity or greater must pass ASTM B117 3000 hour salt spray test as installed. For equipment installed within 1000 feet of the ocean corrosion resistance must pass ASTM B117 6000 hour salt spray test as installed.

For packaged equipment (outdoor heat pumps, air conditioning units, air handling units) less than 10 ton capacity, such equipment must be provided with the manufacturer's seacoast/coastal anti-corrosion options.

Heat transfer ratings of equipment must be indicated within the equipment submittals with consideration for the deratings associated with the corrosion protection systems as installed.

2.11 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.12 DUCT SYSTEMS

2.12.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with ANSI/SMACNA 006, as supplemented and modified by this specification .

- a. Construct ductwork meeting the requirements for the duct system static pressure as indicated on the Ductwork Construction and Leakage Testing Table provided on the drawings.
- b. 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.
- c. Provide branch duct supply take-offs and return connections to main ductwork using 45 degree branch connections or conical tap connections .
- d. Provide ductwork that meets the requirements of Seal Class A.
- e. 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 Volatile Organic Compounds (VOC) content requirements of SCAQMD Rule 1168 (HVAC duct sealants are classified as "Other" within the SCAQMD Rule 1168 sealants table). The VOC emittance must be 420 g/l or less. Provide validation of indoor air quality for duct sealants.
- f. 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 ANSI/SMACNA 006. 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.
- g. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams. .

2.12.1.1 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 pressure and 1.5 inches water gauge negative pressure. 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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.

2.12.1.2 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/square yard glass fabric duct connectors coated on both sides with neoprene. Where 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.

2.12.1.3 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-retardant fabrics" in UL Bld Mat Dir.

2.12.1.4 High Temperature Service Duct Connections

Provide material that is approximately 3/32 inch thick, 35 to 40-ounce per square yard weight, plain weave fibrous glass cloth with, nickel/chrome wire reinforcement for service in excess of 1200 degrees F.

2.12.1.5 Aluminum Ducts

ASTM B209/B209M, alloy 3003-H14 for aluminum sheet and alloy 6061-T6 or equivalent strength for aluminum connectors and bar stock.

2.12.1.6 Copper Sheets

ASTM B152/B152M, light cold rolled temper.

2.12.1.7 Corrosion Resisting (Stainless) Steel Sheets

ASTM A240/A240M

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.12.1.8 Galvanized Steel Sheets

ASTM A653/A653M and ASTM A924/A924M

2.12.2 Duct Access Doors

Provide hinged access doors conforming to ANSI/SMACNA 006 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.

2.12.3 Fire Dampers

Use 1.5 hour rated fire dampers unless otherwise indicated. Provide fire dampers that conform to the requirements of NFPA 90A and UL 555. Perform the fire damper test as outlined in NFPA 90A. Provide automatic operating fire dampers with a dynamic rating suitable for the maximum air velocity and pressure differential to which it is subjected. Provide fire dampers approved for the specific application, and install according to their listing. Equip fire dampers with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, does not impair the operation of the damper. Equip sleeves or frames with perimeter mounting angles attached on both sides of the wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies in conformance with UL Fire Resistance. Provide curtain type with damper blades out of the air stream fire dampers. Install dampers that do not reduce the duct or the air transfer opening cross-sectional area. Install dampers so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, comply with the installation details given in SMACNA 1819 and in manufacturer's instructions for fire dampers. Perform acceptance testing of fire dampers according to paragraph DAMPER ACCEPTANCE TEST and NFPA 80.

2.12.4 Manual Balancing Dampers

- a. Furnish factory manufactured and assembled manual balancing dampers with accessible locking-type quadrant operators. Manufacturer must publish damper data sheets and dampers must be sold on the open market. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building where ductwork is exposed.
- b. Furnish stand-off mounting brackets, bases, or adapters, not less than the thickness of the insulation, to provide clearance between the duct surface and the operator. Stand-off mounting items are to be integral with the operator or standard accessory of the damper manufacturer. For duct widths greater than 30 inches, provide locking regulator at each end of the damper shaft.
- c. Dampers installed in ductwork with an air velocity over 1500 feet per minute, or pressure class greater than 2 inches must be rated for the

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

design velocity and pressure class indicated.

2.12.4.1 Single Blade Round Dampers

- a. May be furnished up to 20 inches in diameter.
- b. Provide a minimum 3/8 inch square continuous full length galvanized or plated steel axle shaft that supports the entire blade diameter and extends through the standoff bracket and quadrant operator. Firmly affix the axle shaft to the blade. Spring-loaded positioners are not permitted.
- c. Must be factory fabricated in a frame with a minimum length of 6 inches made of galvanized steel with straightening ribs; minimum of 22 gage up to 8 inch diameter, and 20 gage above 8 inch diameter. Damper frames are to be mounted end to end with round duct. Support the axle shaft on both ends with a pressed in elastomeric bearing/seal, for low infiltration/exfiltration air leakage.
- d. Provide galvanized steel damper blade; minimum of 22 gage up to 8 inch diameter, and 20 gage above 8 inch diameter.

2.12.4.2 Single Blade Rectangular Dampers

- a. May be furnished up to 12 inches in height for rectangular ducts.
- b. Provide square galvanized or plated steel axle shaft(s) that support the blade at both ends and extends through the standoff bracket and quadrant operator; minimum 3/8 inch up to 19 inch blade length, and 1/2 inch over 19 inch blade length. Firmly affix the axle shaft(s) to the blade. Spring-loaded positioners are not permitted. Provide, at the duct wall shaft penetration, an elastomeric seal for low infiltration/exfiltration air leakage.
- c. Must be factory fabricated in a frame with a minimum length 3 inches made of galvanized steel; minimum of 24 gage up to 19 inch blade length, and 22 gage over 19 inch blade length. Damper frames are to be mounted inside the duct. Support axle shaft on both ends with a bearing in the frame.
- d. Provide damper blades made of galvanized steel with roll formed or broke stiffener(s); minimum of 20 gage up to 19 inch blade length, and 18 gage over 19 inch blade length.

2.12.4.3 Multi-blade Rectangular Dampers

- a. Furnish for round ducts larger than 20 inch and rectangular duct greater than 12 inches in height, except flanged duct system. Furnish square to round transitions for application in round duct.
- b. Provide 1/2 inch galvanized or plated steel axle shafts that support each blade at both ends. Extend the operator shaft through the standoff bracket and quadrant operator. An elastomeric seal for low infiltration/exfiltration air leakage must be at the duct wall shaft penetration.
- c. Must be factory fabricated in a frame with a minimum length of 5 inches made of minimum 16 gage galvanized steel. Damper frames are to be mounted inside the duct. Support axle shafts on both end with a

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

bearing in the frame. Blade linkage must be galvanized or plated steel and concealed in the frame, out of the air stream.

- d. Provide opposed blades made of galvanized steel with roll formed or broke stiffeners(s); minimum of 16 gage.

2.12.4.4 Rectangular Dampers for Flanged Duct

- a. Provide for flanged duct systems.
- b. Must be multi-blade rectangular.
- c. Provide 1/2 inch galvanized or plated steel axle shafts that support each blade at both ends. Extend the operator shaft through the standoff bracket and quadrant operator.
- d. Must be factory fabricated in a frame with a minimum length of 3 inches made galvanized steel with a thickness to match the duct and at least 16 gage, or 20 gage with additional reinforcing such as a C channel. Mount damper frames end to end with the duct. Support axle shafts on both ends with a pressed in elastomeric bearing/seal for low infiltration/exfiltration air leakage. Provide galvanized or plated steel blade linkage, concealed in a frame, out of the air stream.
- e. Provide opposed blades made of galvanized steel with roll formed or broker stiffeners(s); minimum of 16 gage.

2.12.5 Automatic Balancing Dampers

Provide pressure independent automatic balancing dampers at locations as shown on the plans or in accordance with drawing schedules. Automatic balancing dampers must operate without a required power supply and be field adjustable to design airflows without the use of tools using a slide setpoint indicator on the face of the damper. Automatic balancing dampers must be rated for operation with air temperatures ranging from 25 degrees to 140 degrees F. Automatic air balancing dampers must provide airflow within 10 percent of setpoint at air pressures from 0.2 inch to 1.2 inch water column when tested in accordance with AMCA 500-D.

2.12.6 Automatic Smoke-Fire Dampers

Multiple blade type with airfoil type blades, 180 degrees F fusible fire damper link; smoke damper assembly to include electric damper operator. UL 555 as a 1.5 hour rated fire damper; further qualified under UL 555S as a leakage rated damper. Provide a leakage rating under UL 555S that is no higher than Class II at an elevated temperature Category B (250 degrees F for 30 minutes).

2.12.7 Automatic Smoke Dampers

UL listed multiple blade type with airfoil type blades, supplied by smoke damper manufacturer, with pneumatic electric damper operator as part of assembly. Qualified under UL 555S with a leakage rating no higher than Class II or III at an elevated temperature Category B (250 degrees F for 30 minutes).

2.12.8 Air Supply And Exhaust Air Dampers

Provide outdoor air supply and exhaust air dampers that have a maximum

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

2.12.9 Gravity Backdraft and Relief Dampers

Provide gravity balanced backdraft dampers where indicated on plans or as required on equipment schedules. Backdraft dampers must be constructed for horizontal or vertical mounting as required for the application. Backdraft dampers must be tested and rated for the required application in accordance with AMCA 500-D.

Damper blades are to be equipped with neoprene blade seals mechanically locked into the blade edge.

Equip with adjustable counterbalancing weights to allow operation of the blades such that "start to open" occurs at 0.02 inch w.g. and the damper achieves fully open position at 12.5 pascals.

Where backdraft dampers are provided as an accessory option to a fan, such backdraft dampers must be installed meeting all manufacturer's recommendations. The installer must demonstrate that the damper closes once the fan ceases operation.

2.12.10 Plenums and Casings for Field-Fabricated Units

2.12.10.1 Plenum and Casings

Fabricate and erect plenums and casings as shown in ANSI/SMACNA 006, 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 A240/A240M, 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.

2.12.10.2 Casing

Terminate casings at the curb line and bolt each to the curb using galvanized angle, as indicated in ANSI/SMACNA 006.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.12.10.3 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.

2.12.10.4 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 ANSI/SMACNA 006. Construct the plenums and casings to withstand the specified internal pressure of the air systems.

2.12.10.5 Duct Liner

Unless otherwise specified, duct liner is not permitted.

2.12.11 Sound Attenuation Equipment

2.12.11.1 Systems with total pressure above 4 Inches Water Gauge

Provide sound attenuators on the discharge duct of each fan operating at a total pressure above 4 inch water gauge, and, when indicated, at the intake of each fan system. Provide sound attenuators elsewhere as indicated. Provide factory fabricated sound attenuators, tested by an independent laboratory for sound and performance characteristics. Provide a net sound reduction as indicated. Maximum permissible pressure drop is not to exceed 0.63 inch water gauge. Construct traps to be airtight when operating under an internal static pressure of 10 inch water gauge. Provide air-side surface capable of withstanding air velocity of 10,000 fpm. Certify that the equipment can obtain the sound reduction values specified after the equipment is installed in the system and coordinated with the sound information of the system fan to be provided. Provide sound absorbing material conforming to ASTM C1071, Type I or II. Provide sound absorbing material that meets the fire hazard rating requirements for insulation specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. For connection to ductwork, provide a duct transition section. Factory fabricated double-walled internally insulated spiral lock seam and round duct and fittings designed for high pressure air system can be provided if complying with requirements specified for factory fabricated sound attenuators, in lieu of factory fabricated sound attenuators. Construct the double-walled duct and fittings from an outer metal pressure shell of zinc-coated steel sheet, 1 inch thick acoustical blanket insulation, and an internal perforated zinc-coated metal liner. Provide a sufficient length of run to obtain the noise reduction coefficient

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

specified. Certify that the sound reduction value specified can be obtained within the length of duct run provided. Provide welded or spiral lock seams on the outer sheet metal of the double-walled duct to prevent water vapor penetration. Provide duct and fittings with an outer sheet that conforms to the metal thickness of high-pressure spiral and round ducts and fittings shown in ANSI/SMACNA 006. Provide acoustical insulation with a thermal conductivity "k" of not more than 0.27 Btu/inch/square foot/hour/degree F at 75 degrees F mean temperature. Provide an internal perforated zinc-coated metal liner that is not less than 24 gauge with perforations not larger than 1/4 inch in diameter providing a net open area not less than 10 percent of the surface.

2.12.11.2 System with total pressure of 4 Inch Water Gauge and Lower

Use sound attenuators only where indicated. Provide factory fabricated sound attenuators that are constructed of galvanized steel sheets. Provide attenuator with outer casing that is not less than 22 gauge. Provide fibrous glass acoustical fill. Provide net sound reduction indicated. Obtain values on a test unit not less than 24 by 24 inches outside dimensions made by a certified nationally recognized independent acoustical laboratory. Provide air flow capacity as indicated or required. Provide pressure drop through the attenuator that does not exceed the value indicated, or that is not in excess of 15 percent of the total external static pressure of the air handling system, whichever is less. Acoustically test attenuators with metal duct inlet and outlet sections while under the rated air flow conditions. Include with the noise reduction data the effects of flanking paths and vibration transmission. Construct sound attenuators to be airtight when operating at the internal static pressure indicated or specified for the duct system, but in no case less than 2 inch water gauge.

2.12.11.3 NOT USED

2.12.12 Diffusers, Registers, and Grilles

Provide factory-fabricated units of corrosion-resistant steel or 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 units with sound ratings at design conditions not exceeding the ASHRAE Applications Handbook, Noise and Vibration Control Chapter - table "Design Guidelines for HVAC-Related Background Sound in Rooms" refer to drawing air device schedule for maximum permissible sound rating by device. 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.

2.12.12.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. 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.

2.12.12.2 NOT USED

2.12.12.3 NOT USED

2.12.12.4 NOT USED

2.12.12.5 Registers and Grilles

Provide registers and grilles of the types indicated on the drawings. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Install wall supply registers at least 6 inches below the ceiling unless otherwise indicated. Locate return and exhaust registers 6 inches above the floor unless otherwise indicated. Provide grilles as specified for registers, without volume control damper.

2.12.12.6 NOT USED

2.12.12.7 NOT USED

2.12.12.8 NOT USED

2.12.12.9 NOT USED

2.12.12.10 NOT USED

2.12.13 NOT USED

2.12.14 NOT USED

2.12.15 NOT USED

2.12.16 NOT USED

2.12.17 Pre Manufactured Double Wall Ductwork

For all interior exposed ductwork in finished/occupied spaces as indicated

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

on plans provide double wall pre-insulated ductwork with minimum 24 gauge solid galvanized inner wall. Double wall ductwork and fittings are to be from a single manufacturer. Provide ducts with clear internal dimensions of the inner duct equal to the duct dimensions indicated on the plans. Construct the outer duct of galvanized sheet steel, unless otherwise indicated. Double wall duct must comply with ANSI/SMACNA 006 based on static pressure class as indicated on the drawings, and be sealed in accordance to SMACNA Seal Class A requirements.

2.12.17.1 Double Wall Duct Insulation

Insulation thickness as installed must meet or exceed the thermal performance requirements of ASHRAE 90.1 - IP. Interstitial insulation may be one of the following:

- a) Fibrous glass duct liner complying with ASTM C1071 and NFPA 90A or NFPA 90B. Fibrous glass duct liner insulation must be installed in the interstitial space with spacers that position the inner duct at a uniform distance from the outer duct without compressing the insulation. Provide with antimicrobial coating and cover with polyester film complying with UL 181 Class 1.
- b) Flexible elastomeric duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

2.12.18 NOT USED

2.12.19 NOT USED

2.13 AIR SYSTEMS EQUIPMENT

2.13.1 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 belt driven fans less than 5 hp with adjustable pitch motor sheaves selected such that the pitch adjustment is at the middle of the adjustment range at fan design condition. Provide fixed pitch motor sheaves for motors 5 hp and above sized to produce fan design condition. Provide replacement sheaves as 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 required by ASHRAE Applications Handbook - Table "Selection Guide for Vibration Isolation. Use vibration-isolation units that are standard products with published

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide units with sound ratings at design conditions that will not result in objectional background noise in accordance with the ASHRAE Applications Handbook, chapter Noise and Vibration Control, table "Design Guidelines for HVAC-Related Background Sound in Rooms". Obtain the sound power level values according to AMCA 300. Provide power ventilators that conform to UL 705 and have a UL label.

2.13.1.1 NOT USED

2.13.1.2 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Mount fans in a welded tubular casing. Provide a fan that axially flows the air in and out. Streamline inlets with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Enclose and isolate fan bearings and drive shafts from the air stream. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide motors with opendrip-proof enclosure.

2.13.1.3 NOT USED

2.13.1.4 NOT USED
indicated.

2.13.1.5 NOT USED

2.13.1.6 NOT USED

2.13.1.7 NOT USED

2.13.1.8 NOT USED

2.13.1.9 NOT USED

2.13.1.10 NOT USED

2.13.2 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 copper tube wall thickness that is a minimum of 0.020 inches.. Provide aluminum fins that are 0.0055 inch minimum thickness. Provide copper fins that are 0.0045 inch minimum thickness. Provide casing and tube support sheets that are not lighter than 16 gauge galvanized steel,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

2.13.2.1 Direct-Expansion Coils

Provide suitable direct-expansion coils for the refrigerant involved. Provide refrigerant piping that conforms to ASTM B280 and clean, dehydrate and seal. Provide seamless copper tubing suction headers or seamless or resistance welded steel tube suction headers with copper connections. Provide supply headers that consist of a distributor which distributes the refrigerant through seamless copper tubing equally to all circuits in the coil. Provide circuited tubes to ensure minimum pressure drop and maximum heat transfer. Provide circuiting that permits refrigerant flow from inlet to suction outlet without causing oil slugging or restricting refrigerant flow in coil. Provide field installed coils which are completely dehydrated and sealed at the factory upon completion of pressure tests. Pressure test coils in accordance with UL 1995.

2.13.2.2 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.

2.13.2.3 NOT USED

2.13.2.4 NOT USED

2.13.2.5 NOT USED

2.13.2.6 Eliminators

Equip each cooling coil having an air velocity of over 400 fpm through the net face area with moisture eliminators, unless the coil manufacturer guarantees, over the signature of a responsible company official, that no moisture can be carried beyond the drip pans under actual conditions of operation. Construct of minimum 24 gage copper nickel or stainless steel, removable through the nearest access door in the casing or ductwork. Provide eliminators that have not less than two bends at 45 degrees and are spaced not more than 2-1/2 inches center-to-center on face. Provide each bend with an integrally formed hook as indicated in the SMACNA 1884.

2.13.2.7 Sprayed Coil Dehumidifiers

Provide assembly with reinforced, braced, and externally insulated galvanized steel casing, vertical in-line spray pump, bronze self-cleaning spray nozzles, galvanized steel pipe spray headers, adjustable float valve with replaceable neoprene seat, manufacturer's standard cooling coil, and welded black steel drain tank. Provide overflow drain, make-up, and bleed connection.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.13.3 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.

2.13.3.1 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.

2.13.3.2 NOT USED

2.13.3.3 NOT USED

2.13.3.4 NOT USED

2.13.3.5 Replaceable Media Filters

Provide the dry-media type replaceable media filters, of the size required to suit the application. Provide filtering media that is not less than 2 inches thick fibrous glass media pad supported by a structural wire grid or woven wire mesh. Enclose pad in a holding frame of not less than 16 gauge galvanized steel, equipped with quick-opening mechanism for changing filter media. Base the air flow capacity of the filter on net filter face velocity not exceeding 300 fpm, with initial resistance of 0.13 inches water gauge. Provide MERV that is not less than 8 when tested according to ASHRAE 52.2.

2.13.3.6 NOT USED

2.13.3.7 NOT USED

2.13.3.8 NOT USED

2.13.3.9 NOT USED

2.13.3.10 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.

2.13.3.11 Filter Gauges

Provide dial type filter gauges, diaphragm actuated draft for all filter stations, including those filters which are furnished as integral parts of

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 taps with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter vinyl tubing, and all hardware and accessories for gauge mounting.

2.14 AIR HANDLING UNITS

2.14.1 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.

2.14.2 Factory-Fabricated Air Handling Units

Provide single-zone draw-through type or multizone blow-through type units as indicated. Units must include fans, coils, airtight insulated casing, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, mixing box vibration-isolators, and appurtenances required for specified operation. Provide fan and motor assemblies with vibration-isolation supports or mountings as required by ASHRAE Applications Handbook - Table "Selection Guide for Vibration Isolation. 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.

2.14.2.1 Casings

Provide the following:

- a. Casing sections 2 inch double wall type, constructed of a minimum 22 gauge galvanized steel, 0.040 inch aluminum, or 22 gauge stainless steel conforming to ASTM A240/A240M, Type 304. Make the inner casing of double wall units a minimum 20 gauge solid galvanized steel. Design and construct casing with an integral insulated structural galvanized steel or aluminum frame such that exterior panels are non-load bearing.

Incorporate a standing seam or thermoplastic polyolefin (TPO) on the exterior of outdoor unit roofs to ensure a rigid roof construction and prevent water infiltration. Roof assembly must be sloped not less than 1:100 for drainage and is to overhang all walls by 1.5 inch minimum to prevent sheeting from roof to side panels. Rain gutters are to also be provided over all doors shorter than total unit height to direct rain away from door assembly. Where outdoor units are shipped in multiple sections, provide standing-seam joiners at each split with adhesive, hardware, and cover strips for field joining by the installing contractor.

Unit casing (wall/floor/roof panels and doors) must be able to withstand up to 1.5 times design static pressure, or 8-inch water gauge and not exceed 0.0042 per inch of panel span (L/240) when measured at the panel midpoint. Air leakage to be guaranteed at no more than 1 percent of the design volume at 1.5 times the design operating

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

pressure or 50 cubic feet per minute, whichever is greater. Specified air leakage accomplished without the use of caulk. Total estimated air leakage reported for each unit in cubic feet per minute or as a percentage of supply air.

- b. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break is provided for all unit casing panels. Individually removable exterior panel sections are removable 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 must be capable of opening a minimum of 90 degrees.
- c. Insulated, fully gasketed, double-wall type inspection and access doors, of a minimum 22 gauge galvanized steel, 0.040 inch aluminum, or 22 gauge stainless steel conforming to ASTM A240/A240M. 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 20 gauge stainless steel conforming to ASTM A240/A240M, 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. Drain connections must be of the same material as the primary drain pan and extend a minimum of 2-1/2 inch beyond the base to ensure adequate room for field piping of condensate traps.
- e. Casing insulation that conforms to NFPA 90A. 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 inspection doors.
- 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- h. A latched and hinged inspection door, in the fan and coil sections. Plus additional inspection doors, access doors and access sections where indicated.

2.14.2.2 Heating and Cooling Coils

Provide coils as specified in paragraph AIR SYSTEMS EQUIPMENT.

2.14.2.3 Air Filters

Provide air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.14.2.4 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.
- c. Fans that are driven by a unit-mounted, or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Furnish belt guards that are the three-sided enclosed type with solid or expanded metal face. Design belt drives for not less than a 1.3 service factor based on motor nameplate rating.
- d. Motor sheaves that are variable pitch for motors below 5 hp and fixed pitch at or above 5 hp. Where fixed sheaves are required, the use of variable pitch sheaves is allowed during air balance, but replace them with an appropriate fixed sheave after air balance is completed. Select variable pitch sheaves to drive the fan at a speed that produces the specified capacity when set at the approximate midpoint of the sheave adjustment. Furnish motors for V-belt drives with adjustable bases, and with totally enclosed enclosures.
- e. Motor starters of magnetic type with general-purpose enclosure.

2.14.2.5 Fan Arrays

Air handling units utilizing fan arrays are to comply with the following requirements:

- a. Fans require Class II (minimum) construction with single inlet, direct

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

drive ACMA Arrangement 4 fans installed either in a modular fashion in the field or pre-assembled on a prefabricated frame. Fans must be dynamically balanced and internally isolated to minimize vibration. Fan performance rated in accordance with AMCA 210.

- b. Fan array plenum type fans driven by variable speed drives unless otherwise indicated; where indicated fans are driven by brushless DC electronically commutated motor (ECM) with external rotor and integrated maintenance free, permanently lubricated ball bearings and statically and dynamically balanced in accordance with ISO 21940-11. The ECM must be closed, protection level IP 54, thermal class 155; motor efficiency class complies with IEC 60034-30-1 IE3 Premium efficiency.
- c. Fan array controller provided by the air handling unit manufacturer to control the fan array modulating individual fan speed and number of active fans to provide the required airflows with minimum energy consumption.

2.14.2.6 Access Sections and Filter/Mixing Boxes

Provide access sections where indicated and furnish with access doors. 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.

2.14.2.7 NOT USED

2.14.2.8 Dampers

Provide dampers integral to factory fabricated air handling units constructed in accordance with 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC. Dampers connecting the air handling unit to the outdoors (outdoor air, exhaust air, relief Air) must be AMCA 511 leakage classification 1A.

2.15 TERMINAL UNITS

2.15.1 NOT USED

2.15.2 Variable Air Volume (VAV) and Dual Duct Terminal Units

- a. Provide VAV and dual duct terminal units that are the type, size, and capacity shown, mounted in the ceiling or wall cavity, plus units that are suitable for single or dual duct system applications. Provide actuators and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. For each VAV terminal unit, provide a temperature sensor in the unit discharge ductwork.
- b. Provide unit enclosures that are constructed of galvanized steel not lighter than 22 gauge or aluminum sheet not lighter than 18 gauge. Provide single or multiple discharge outlets as required. Units with flow limiters are not acceptable. Provide unit air volume that is factory preset and readily field adjustable without special tools.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Provide reheat coils as indicated.

- c. Attach a flow chart to each unit. Base acoustic performance of the terminal units upon units tested according to AHRI 880 I-P with the calculations prepared in accordance with AHRI 885. Provide sound power levels as indicated. Show discharge sound power for minimum and 1-1/2 inches water gauge inlet static pressure. Provide with double wall construction for acoustical attenuation. Solid metal liner must completely isolate insulation from airstream within the unit. Acoustical duct lining is not permitted.
- d. For VAV terminal units provided with heating coils provide a manufacturer's access door to facilitate with the cleaning of the coil and servicing internal components without disturbing duct connections.

2.15.2.1 Constant Volume, Single Duct Terminal Units

Provide constant volume, single duct, terminal units that contain within the casing, a constant volume regulator. Provide volume regulators that control air delivery to within plus or minus 5 percent of specified air flow subjected to inlet pressure from 3/4 to 6 inch water gauge.

2.15.2.2 Variable Volume, Single Duct Terminal Units

Provide variable volume, single duct, terminal units with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Provide units that control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Provide units with an internal resistance not exceeding 0.4 inch water gauge at maximum flow range. Provide external differential pressure taps separate from the control pressure taps for air flow measurement with a 0 to 1 inch water gauge range.

2.15.2.3 Variable Volume, Single Duct, Fan-Powered Terminal Units

Provide variable volume, single duct, fan-powered terminal units with a calibrated air volume sensing device, air valve or damper, actuator, fan and motor, and accessory relays. Provide units that control primary air volume to within plus or minus 5 percent of each air set point as determined by the thermostat with variations in inlet pressure from 3/4 to 6 inch water gauge. Provide unit fan that is centrifugal, direct-driven, double-inlet type with forward curved blades. Provide either single speed with speed controller, ECM motor with electronic speed control or three-speed, permanently lubricated, permanent split-capacitor type fan motor. Isolate fan/motor assembly from the casing to minimize vibration transmission. Provide factory furnished fan control that is wired into the unit control system. Provide a factory-mounted pressure switch to operate the unit fan whenever pressure exists at the unit primary air inlet or when the control system fan operates.

2.15.2.4 Dual Duct Terminal Units

Provide dual duct terminal units with hot and cold inlet valve or dampers that are controlled in unison by single or dual actuators. Provide actuator as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Provide unit that controls delivered air volumes within plus or minus 5 percent with inlet air variations from 1 to 8 inch water gauge in either duct. Include mixing baffles with the unit casing.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Provide cabinet and closed duct leakage that does not exceed 2 percent of maximum rated air volume. Provide units with an internal resistance that does not exceed 0.2 inch water gauge at maximum flow range.

2.15.2.5 Series Fan Powered Variable Air Volume (VAV) Terminals

Provide units factory assembled, designed, tested, rated in accordance with AHRI 880 I-P, that are AHRI certified, listed in the AHRI DCAACP and that produce a supply air discharge mix by modulation of conditioned primary air and recirculating of return air. Provide units that include casing, centrifugal fan and motor, primary VAV damper or valve, electronic volume regulator, discharge air damper, primary air inlet cone with high and low pressure flow sensors, recirculating air filter frames, filter, and electrical disconnect. Provide hot water heating coils integral to the terminal, or provide insulated hot water coil section attached to the discharge of the terminal.

2.15.2.5.1 Casing

Provide removable full bottom access panels for servicing internal components without disturbing duct connections. Insulate inside of casing with manufacturer's standard insulation. Provide units that have recirculating air inlet equipped with filter frame, round primary damper or valve, and unit mounting brackets.

2.15.2.5.2 Fans and Motors

Provide centrifugal, forward curved, multiblade, fan wheels with direct-drive motors. Provide motors that are the high efficiency permanent-split capacitor type with thermal overload protection, permanently lubricated bearings, and have three speeds or are equipped with solid state speed controllers, or ECM motors with electronic speed control capacity may be provided.. Provide isolation between fan motor assembly and unit casing. Provide fan and motor that is removable through casing access panel.

2.15.2.5.3 Flow Sensor

Provide ring or cross type sensor with minimum of two pickup points which average the velocity across the inlet. Obtain flow measurement within plus or minus 5 percent of rated airflow with 1.5 diameters of straight duct upstream of unit and inlet static variation of 0.5 to 5.0 inches water gauge. Supply flow measuring taps and calibration flowchart with each unit for field balancing airflows.

2.15.2.5.4 Primary VAV Damper or Valve

Provide galvanized steel damper blade that closes against gasket inside unit. Connect damper to operating shaft with a positive mechanical connection. Provide nylon bearing for damper shaft. Cylindrical die cast aluminum valve inlet tapered to fit round flexible ducts with integral flow diffuser and beveled self-centering disc. Provide damper or valve leakage at shutoff that does not exceed 2 percent of capacity at 1 inch water gauge pressure.

2.15.2.5.5 Regulator

Provide electronic volume regulator. Electronic controls contained in NEMA ICS 6, Type 1 enclosure sealed from airflow. Provide unit with

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

controls mounted on side or on air valve. System powered regulators are not permitted. Provide volume regulator that resets primary air volume as determined by thermostat, within upstream static pressure variation noted in paragraph titled "Flow Sensor." Provide volume regulators that are field adjustable, factory set and calibrated to indicated maximum and minimum primary airflows, direct acting and normally closed upon loss of pneumatic pressure.

2.15.2.5.6 Electrical

Provide unit that incorporates single point electrical connection with electrical disconnect. Provide electrical components that are UL or ETL listed, installed in accordance with NFPA 70 and mounted in control box. Units UL or ETL listed as an assembly do not require airflow switch interlock with electric heating coil, when factory assembled.

2.15.2.5.7 Filters

Provide UL listed throwaway one inch thick fiberglass filters, standard dust-holding capacity.

2.15.2.6 Reheat Units

2.15.2.6.1 Hot Water Coils

Provide fin-and-tube type hot-water coils constructed of seamless copper tubes and copper or aluminum fins mechanically bonded or soldered to the tubes. Provide headers that are constructed of cast iron, welded steel or copper. Provide casing and tube support sheets that are 16 gauge, galvanized steel, formed to provide structural strength. Provide tubes that are correctly circuited for proper water velocity without excessive pressure drop and are drainable where required or indicated. At the factory, test each coil at not less than 250 psi air pressure and provide coils suitable for 200 psi working pressure. Install drainable coils in the air handling units with a pitch of not less than 1/8 inch per foot of tube length toward the drain end. Coils must conform to the provisions of AHRI 410.

2.15.2.6.2 NOT USED

2.15.2.6.3 NOT USED

2.15.3 NOT USED

2.16 NOT USED

2.17 SUPPLEMENTAL COMPONENTS/SERVICES

2.17.1 Chilled, Condenser, or Dual Service Water Piping

The requirements for chilled, condenser, or dual service water piping and accessories are specified in Section 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.17.2 Refrigerant Piping

The requirements for refrigerant piping are specified in Section 23 23 00 REFRIGERANT PIPING.

2.17.3 NOT USED

2.17.4 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates cooling coil condensate in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.17.5 Backflow Preventers

The requirements for backflow preventers are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.17.6 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.17.7 Controls

The requirements for controls are specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS and Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS.

2.18 NOT USED

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 3 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 assuring mounting height accommodates depth of condensate drain water seal (trap) where applicable. 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. Provide concrete for foundations as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

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. Provide access panels as specified in Section 08 31 00 ACCESS DOORS AND PANELS.

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 ANSI/SMACNA 006 unless otherwise indicated. Install duct supports for sheet metal ductwork according to ANSI/SMACNA 006, unless otherwise specified. Do not use friction beam clamps indicated in ANSI/SMACNA 006. 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

3.2.5.1 NOT USED

3.2.5.2 NOT USED

3.2.5.3 NOT USED

3.2.6 NOT USED

3.2.7 NOT USED

3.2.8 NOT USED

3.2.9 NOT USED

3.2.10 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

3.2.11 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 up to the point where the outdoor air mixes with the return air stream.

3.2.12 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2.13 NOT USED

3.2.14 NOT USED

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 28 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, laboratory or warehouse 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. Refer to design details on the drawings for sleeves in bearing walls or partitions.

3.6.2 Framed Prepared Openings

Fabricate framed prepared openings from 20 gauge galvanized steel, unless

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 except firewall penetrations. Terminate duct insulation at fire dampers and flexible connections. For duct handling air at or below 60 degrees F, provide insulation continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air.

3.6.4 Closure Collars

Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over 15 inches from 18 gauge galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge galvanized steel. Install collars with fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

3.6.5 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.

3.7.2 Temperatures between 120 and 400 degrees F

Apply two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of two mils to metal surfaces subject to temperatures between 120 and 400 degrees F.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.7.3 Temperatures greater than 400 degrees F

Apply two coats of 315 degrees C 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of two mils to metal surfaces subject to temperatures greater than 400 degrees F.

3.7.4 Finish Painting

The requirements for finish painting of items only primed at the factory, and surfaces not specifically noted otherwise, are specified in Section 09 90 00 PAINTS AND COATINGS.

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.

3.8.1 Identification of Hidden Utility Components

Provide labeling for equipment installed above the ceiling that requires periodic inspection or servicing. The labeling must be stick-on adhesive type with black lettering on white or clear background with lettering a minimum of 1/2" in height. For lay-in ceiling applications, locate stick-on on ceiling grid T-Bars closest to equipment such that recommended ceiling tile to be removed for servicing/access is direction above the label. For equipment located above hard ceilings, labeling is to be provided on the provided access door. The operable equipment requiring identification include, valves, dampers, VAV terminal boxes, fans, and .

3.9 DUCTWORK LEAK TESTS

The requirements for ductwork leak tests are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC.

3.10 DAMPER ACCEPTANCE TEST

Submit the proposed schedule, at least 2 weeks prior to the start of test. Perform the damper acceptance test in accordance with NFPA 80. Operate all fire dampers and smoke dampers with the air handling and distribution system operating at maximum air flow conditions, prior to the occupancy of the building to verify that they function properly. Test each fire damper with a fusible link by manually releasing the damper. Visually inspect the mechanism. Reset all fire dampers after acceptance testing.

3.11 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.12 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.

3.13 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Inside of air terminal units, 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. Temporary filters must be provided and used when any air distribution system is in operation during construction. 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.

3.14 NOT USED

3.15 OPERATION AND MAINTENANCE

3.15.1 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

3.15.2 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 --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 36 00.00 40

AIR TERMINAL UNITS

08/22

PART 1 GENERAL

Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section.

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 DUCT COUNCIL (ADC)

ADC Standards Manual (2008; 5th Edition) Flexible Duct
Performance Installation Standards

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 880 I-P (2011) Performance Rating of Air Terminals

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

ASHRAE 130 (2008) Method of Testing for Rating Ducted
Air Terminal Units

ASTM INTERNATIONAL (ASTM)

ASTM C1071 (2019) Standard Specification for Fibrous
Glass Duct Lining Insulation (Thermal and
Sound Absorbing Material)

ASTM E84 (2023) Standard Test Method for Surface
Burning Characteristics of Building
Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2023) National Electrical Code

NFPA 90A (2024) Standard for the Installation of
Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 181 (2013; Reprint Dec 2021) UL Standard for
Safety Factory-Made Air Ducts and Air
Connectors

UL 486A-486B (2018; Reprint May 2021) UL Standard for
Safety Wire Connectors

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.2 ADMINISTRATIVE REQUIREMENTS

Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, communication and security systems, and partition assemblies.

1.2.1 Pre-Installation Meetings

Submit itemized lists for all materials, equipment, and fixtures to be incorporated in the work 30 days prior to commencement of work. Ensure list includes manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. Submit product data for each type of air terminal unit indicated, including rated capacities, furnished specialties, sound-power ratings, and accessories:

- a. Bypass Single-Duct Air Terminal Units
- e. Shutoff Single-Duct Air Terminal Units
- f. Integral-Diffuser Air Terminal Units

Submit records of existing conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of existing conditions.

Submit shop drawings which detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished. Include wiring diagrams to show power, signal, and control wiring.

Provide units with the configuration, capacity, and static-pressure characteristics indicated.

Ensure dimensional data stated constitutes nominal sizing, which has been adjusted by the manufacturer when necessary to accommodate acoustic material thickness.

Ensure units proposed are identical to units having at least 2 years of proven satisfactory field service.

Provide certification that units and the list of spare parts are ADC Standards Manual tested and rated.

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 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Records of Existing Conditions

SD-02 Shop Drawings

Bypass Single-Duct Air Terminal Units; G, ae
Dual-Duct Air Terminal Units; G
Fan-Powered Air Terminal Units; G
Induction Air Terminal Units; G
Shutoff Single-Duct Air Terminal Units; G, ae
Integral-Diffuser Air Terminal Units; G, ae
High-Pressure Dual-Duct Mixing Boxes; G
Low-Pressure Dual-Duct Mixing Boxes; G

SD-03 Product Data

Bypass Single-Duct Air Terminal Units; G, ae
Dual-Duct Air Terminal Units; G
Fan-Powered Air Terminal Units; G
Induction Air Terminal Units; G
Shutoff Single-Duct Air Terminal Units; G, ae
Integral-Diffuser Air Terminal Units; G, ae
High-Pressure Dual-Duct Mixing Boxes; G
Low-Pressure Dual-Duct Mixing Boxes; G

SD-06 Test Reports

Test Report

SD-07 Certificates

List of Spare Parts

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Record Drawings

1.4 QUALITY CONTROL

Indicate on drawings the size, profiles, and dimensional requirements of air terminal units that are based on the specific system indicated.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Conform to NFPA 70, Article 100 for electrical components, devices, and accessories. List and label items as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

Ensure Air Terminals are certified under the AHRI 880 I-P Certification Program and carry the ARI Seal.

When air terminal devices are furnished with reheat coils, either integrally or remotely mounted, control panels of terminal devices shall be mounted on the same side of air terminal device as reheat coil piping connection.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 Verification of Performance

Rate air terminal units according to AHRI 880 I-P.

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 Integral-Diffuser Air Terminal Units

2.1.7.1 Configuration

Provide a volume-damper assembly inside unit casing with integral diffuser.

2.1.7.2 Casing

Provide 0.034-inch steel casing. Ensure the casing includes an integral mixing baffle to efficiently mix the hot and cold airstream.

a. Casing Lining

Provide 1/2-inch thick, coated, fibrous-glass duct casing lining complying with ASTM C1071. Secure with adhesive. Cover liner with nonporous foil.

Attach a 3/4-inch thick adhesive of polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25, and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E84. Coat any cut edges of fiberglass exposed to the airstream with NFPA 90A approved seal.

For the air inlet provide round stub connection for duct attachment. For the air outlet provide s-slip and drive connections. Provide removable panels for access to diverter and other parts requiring service, adjustment, or maintenance; with airtight gasket.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.1.7.3 Volume Damper

Provide galvanized steel with peripheral gasket and self-lubricating bearings.

Damper Position: Normally open .

2.1.7.4 Diffuser

Provide a galvanized-steel insulated plenum with extruded-aluminum or sheet-steel diffuser, having fixed or variable geometry designed to operate from 100 percent to minimum airflow, manual adjustment of airflow direction, and a baked-enamel finish.

2.1.7.5 Electric Controls

a. Damper Actuator

Provide a 24 V, powered closed, powered open.

b. Thermostat

Provide a wall-mounting electronic type thermostat with clock display, temperature display in Celsius and Fahrenheit, and space temperature set point.

2.1.7.6 NOT USED

2.1.7.7 Electronic Controls

Provide bidirectional damper operator and microprocessor-based thermostat with integral airflow transducer. Provide with room sensor that is compatible with temperature controls specified.

a. Damper Actuator

Provide a 24 V, powered closed, powered open.

b. Velocity Controller

Provide a factory calibrated velocity controller, field adjustable to minimum and maximum air volumes. Ensure controller is capable of maintaining constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg when tested in accordance with ASHRAE 130. Provide controller with a multipoint velocity sensor at air inlet.

c. Thermostat

Provide a wall-mounting electronic type thermostat with integral control of room temperature. Ensure thermostat is time-proportional with reheat-coil control feature, and displays a temperature set-point in Celsius and Fahrenheit.

2.1.7.8 Control Sequence

Make suitable for operation with duct pressures between 0.25 and 3.0-inch wg inlet static pressure. Provide factory-mounted and -piped, 5-micron

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

filter; velocity-resetting, adjustable, high-limit control; and amplifying relay with a system-powered, wall-mounting thermostat.

2.1.8 NOT USED

2.1.9 NOT USED

PART 3 EXECUTION

3.1 INSTALLATION

Install air terminal units level and plumb, and in accordance with NFPA 90A. Maintain sufficient clearance for normal service and maintenance.

3.1.1 Identification

Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

3.1.2 Connections

Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.

Install piping adjacent to air terminal units to allow service and maintenance.

3.1.2.1 Hot-Water Piping

Connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

Connect ducts to air terminal units.

Ground units with electric heating coils.

Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

3.2 FIELD QUALITY CONTROL

Perform the following field tests and inspections and prepare a test report.

After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

3.2.1 Leak Test

After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.

3.2.2 Operational Test

After electrical circuitry has been energized, start units to confirm

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

proper motor rotation and unit operation.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest.

3.3 SYSTEM STARTUP

Engage a factory-authorized service representative to perform startup service.

Complete installation and startup checks according to manufacturer's written instructions and do the following:

- a. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
- b. Verify that controls and control enclosure are accessible.
- c. Verify that control connections are complete.
- d. Verify that nameplate and identification tag are visible.
- e. Verify that controls respond to inputs as specified.

3.4 CLOSEOUT ACTIVITIES

3.4.1 Operation and Maintenance

Submit 6 copies of the operation and maintenance manuals 30 calendar days prior to testing the following items. Update and re-submit data for final approval no later than 30 calendar days prior to contract completion. Concurrently, submit record drawings providing current factual information, including deviations and amendments to the drawings, and concealed and visible changes in the work.

3.4.2 Demonstration

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 37 13.00 40

DIFFUSERS, REGISTERS, AND GRILLES

08/22

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.

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

ASHRAE 113	(2022) Method of Testing for Room Air Diffusion
ASHRAE EQUIP IP HDBK	(2012) Handbook, HVAC Systems and Equipment (IP Edition)
ASHRAE FUN IP	(2021) Fundamentals Handbook, I-P Edition

1.2 ADMINISTRATIVE REQUIREMENTS

Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section.

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 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

Material, Equipment, and Fixture Lists

Records of Existing Conditions;

SD-02 Shop Drawings

Fabrication Drawings

Installation Drawings;

SD-03 Product Data

Equipment and Performance Data;

SD-04 Samples

Manufacturer's Standard Color Chart

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SD-10 Operation and Maintenance Data

Type TS Supply Troffer

Type TSR Combination Supply and Return Troffer

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

Certify air diffusion devices having been tested and rated in accordance with Chapter 19-ASHRAE EQUIP IP HDBK, Chapter 16-ASHRAE FUN IP, and ASHRAE 113, where such certification is required.

Submit equipment and performance data for air-diffusion devices consisting of sound data in terms of Noise Criteria (NC) index for the capacity range of the device.

2.2 COMPONENTS

2.2.1 Air Diffusion Device Construction

Preclude flutter, rattle, or vibration on air-diffusion device construction and mounting. Refer to Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT for vibration isolation considerations. Modify devices and provide accessories necessary for mounting in indicated surface construction.

Select color from manufacturer's standard color chart which indicates the manufacturer's standard color selections and finishes for air-diffusion devices.

Provide supply diffusers with combination damper and equalizing grid. Ensure dampers are extracting-splitter type, except as otherwise indicated. Equalizing grids shall consist of individually adjustable vanes designed for equalizing airflow into diffuser neck and providing directional control of airflow.

Ensure air-diffusion device volume and pattern adjustments can be made from the face of the device. Make volume adjustments by removable key .

Provide gaskets for supply-terminal air devices mounted in finished surfaces.

Include within the material, equipment, and fixture lists the manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

Submit records of existing conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of existing conditions.

Submit fabrication drawings for air-diffusion devices consisting of fabrication and assembly details to be performed in the factory.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.2 Types of Air Diffusion Devices

2.2.2.1 NOT USED

2.2.2.2 NOT USED

2.2.2.3 NOT USED

2.2.2.4 NOT USED

2.2.2.5 NOT USED

2.2.2.6 NOT USED

2.2.2.7 NOT USED

Provide straightening grids where indicated.

2.2.2.8 NOT USED

Provide type DLS supply diffuser, linear slot type, extruded aluminum construction, with fully adjustable integral air pattern and volume control vanes that deflect air pattern from horizontal along ceiling to straight down. Ensure any intermediate setting and a pattern control element that permits complete blanking-off of slot.

Slot width: 3/4 inch.

Provide number of slots per unit run as indicated.

Align butts in continuous runs for hairline joints.

Butt ends of diffuser against walls without mitered end caps. Provide end caps where slot terminates.

Provide exposed-to-view part of frame with anodized aluminum, and all interior exposed-to-view components with a black matte finish.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.2.9 NOT USED

2.2.2.10 NOT USED

2.2.2.11 NOT USED

2.2.2.12 NOT USED

2.2.2.13 NOT USED

2.2.2.14 Type GR

Provide type GR return grilles, single deflection type with fixed face bars.

Provide grilles installed in vertical surfaces with horizontal face bars set downward at 45 degrees from vertical.

Provide grilles installed in horizontal surfaces with face bars straight and parallel to short dimension.

Provide a baked enamel finish.

2.2.2.15 NOT USED

2.2.2.16 NOT USED

2.2.2.17 Type GCD

Provide type GCD with an individually adjustable, vertical, curved-blade grilles and a two-way pattern.

Provide a baked enamel finish.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.2.18 NOT USED

2.2.2.19 NOT USED

2.2.2.20 NOT USED

2.2.2.21 NOT USED

2.2.2.22 NOT USED

2.2.2.23 NOT USED

2.2.2.24 NOT USED

Provide aluminum construction.

2.2.2.25 NOT USED

2.2.2.26 NOT USED

2.2.2.27 NOT USED

2.2.2.28 NOT USED

2.2.2.29 NOT USED

2.2.2.30 NOT USED

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment as indicated and specified and in accordance with manufacturer's recommendations.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Submit installation drawings for air-diffusion devices. Indicate on drawings overall physical features, dimensions, ratings, service requirements, and equipment weights.

Unless otherwise indicated, size ductwork drop to diffusers or grilles to match unit collar sizes.

Seal connections between ductwork drops to diffusers or grilles airtight.

Support independently diffusers and grilles for T-bar mounting that exceed weight limit of ceiling suspension system in which they are to be installed.

3.1.1 Operations and Maintenance Manuals

Provide operation and maintenance manuals consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 57 10.00 10

FORCED HOT WATER HEATING SYSTEMS USING WATER AND STEAM HEAT EXCHANGERS 11/19

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 B16.1	(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 B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2024) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2021) Forged Fittings, Socket-Welding and Threaded
ASME B16.15	(2024) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2021) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2021) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2024) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(2025) Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B31.1	(2024) Power Piping
ASME B40.100	(2022) Pressure Gauges and Gauge Attachments

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASME BPVC SEC VIII D1 (2023) BPVC Section VIII-Rules for
Construction of Pressure Vessels Division 1

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606 (2022) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

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

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M (1999; R 2022; E 2022) Standard
Specification for Ferritic Malleable Iron
Castings

ASTM A53/A53M (2024) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

ASTM A105/A105M (2023) Standard Specification for Carbon
Steel Forgings for Piping Applications

ASTM A106/A106M (2019a) Standard Specification for
Seamless Carbon Steel Pipe for
High-Temperature Service

ASTM A183 (2014; R 2020) Standard Specification for
Carbon Steel Track Bolts and Nuts

ASTM A193/A193M (2025) Standard Specification for
Alloy-Steel and Stainless Steel Bolting
Materials for High-Temperature Service and
Other Special Purpose Applications

ASTM A234/A234M (2024) Standard Specification for Piping
Fittings of Wrought Carbon Steel and Alloy
Steel for Moderate and High Temperature
Service

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 A536 (2024) Standard Specification for Ductile
Iron Castings

ASTM A653/A653M (2023) Standard Specification for Steel
Sheet, Zinc-Coated (Galvanized) or
Zinc-Iron Alloy-Coated (Galvannealed) by
the Hot-Dip Process

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASTM A733	(2016; R 2022) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM B251/B251M	(2017) Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
ASTM B650	(2023) Standard Specification for Electrodeposited Engineering Chromium Coatings on Ferrous Substrates
ASTM B687	(1999; R 2023) Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
ASTM B813	(2024) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B828	(2023) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM D1248	(2016) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D2000	(2018; R 2024) Standard Classification System for Rubber Products in Automotive Applications
ASTM D3308	(2012; R 2022) Standard Specification for PTFE Resin Skived Tape

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA Stds	(2015) (10th Ed) EJMA Standards
-----------	---------------------------------

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

MSS SP-25	(2018) Standard Marking System for Valves,
-----------	--

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Fittings, Flanges and Unions

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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

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

NEMA MG 1 (2021) Motors and Generators

PLUMBING-HEATING-COOLING CONTRACTORS ASSOCIATION (PHCC)

NAPHCC NSPC (2015) National Standard Plumbing Code
Illustrated

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2023; with Change 3, 2025) Structural
Engineering

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 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

Heating System

SD-03 Product Data

Spare Parts

Welding

Framed Instructions

SD-06 Test Reports

Testing and Cleaning

Water Treatment Testing

SD-07 Certificates

Bolts

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.3 QUALITY ASSURANCE

Procedures and welders must be qualified in accordance with the code under which the welding is specified to be accomplished.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and excessive temperature variation; and dirt, dust, or other contaminants.

1.5 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, after approval of the related submittals 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.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer 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. Equipment must be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.1.2 Nameplates

Place a plate on each major item of equipment having the manufacturer's name, address, type or style, model or serial number, and catalog number secured to the item of equipment.

2.1.3 Equipment Guards and Access

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard must be properly guarded or covered with insulation of a type specified.

2.1.4 Asbestos Prohibition

Asbestos and asbestos-containing products will not be accepted.

2.1.5 Electrical Work

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls. Electric equipment (including motor efficiencies), and wiring must be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide integral size motors of the premium efficiency type in accordance with NEMA MG 1. Electrical characteristics must be as specified or indicated. Provide motor starters complete with

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

thermal overload protection and other appurtenances necessary for the motor control specified. Each motor must be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring, conduit, and connection to power required for controls and devices but not shown must be provided.

2.2 PIPING, TUBING, AND FITTINGS

2.2.1 General

Piping, tubing, and fittings must be as follows:

c. Condensate return piping must be black steel Schedule 80 with cast iron or malleable iron, Class 250 minimum.

e. Vent piping must be black steel, Schedule 40, with black malleable iron fittings.

2.2.2 Steel Pipe

Pipe must conform to ASTM A53/A53M or ASTM A106/A106M, Grade A or B, black steel, Schedule 40, unless otherwise specified. Steel pipe to be bent must be ASTM A53/A53M, Grade A, standard, or Grade B, extra strong weight. Steam pipe must be ASTM A53/A53M Grade A.

2.2.3 Gauge Piping

Piping must be copper tubing for low temperature water. Use black steel, ASTM A106/A106M, seamless, Grade A pipe for high temperature.

2.2.4 Copper Tubing

Tubing must conform to ASTM B88, ASTM B88M, Type K or L. Tubing for compressed air tubing must conform to ASTM B251/B251M.

2.2.5 Malleable Iron Pipe Fittings

Fittings must conform to ASME B16.3, type required to match adjacent piping.

2.2.6 Cast Iron Pipe Fittings

Fittings must conform to ASME B16.1 or ASME B16.4 type required to match adjacent piping.

2.2.7 Steel Pipe Fittings

Fittings must have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.7.1 Welded Fittings

Welded fittings must conform to ASTM A234/A234M with WPA marking. Butt welded fittings must conform to ASME B16.9, and socket welded fittings must conform to ASME B16.11.

2.2.7.2 Grooved Mechanical Fittings

Standard fittings must be of malleable iron conforming to ASTM A47/A47M, Grade 32510, or ductile iron conforming to ASTM A536, Grade 65-45-12. Fittings may also be constructed of steel, conforming to ASTM A106/A106M, Grade B or ASTM A53/A53M.

2.2.7.3 Grooved Mechanical Pipe Joints

Pipe joints must conform to AWWA C606. Grooved mechanical joint fittings must be full flow factory manufactured forged steel fittings. Fittings, couplings, gaskets, and pipe grooving tool or grooved end pipe must be products of the same manufacturer. Mechanical pipe couplings must be of the bolted type and must consist of a housing fabricated in two or more parts, a synthetic rubber gasket, and nuts and bolts to secure unit together. Housings must be of malleable iron conforming to ASTM A47/A47M, Grade 32510 or ductile iron conforming to ASTM A536, Grade 65-45-12. Coupling nuts and bolts must be of steel and conform to ASTM A183. Submit written certification that the bolts furnished comply with the requirements of this specification, provided by the bolt manufacturer. The certification must include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification. Gaskets must be of molded synthetic rubber, Type EPDM with central cavity, pressure responsive configuration and must conform to ASTM D2000.

2.2.8 Joints and Fittings for Copper Tubing

Wrought copper and bronze fittings must conform to ASME B16.22 and ASTM B75/B75M. Cast copper alloy fittings must conform to ASME B16.18 and ASTM B828. Flared fittings must conform to ASME B16.26 and ASTM B62. Adaptors may be used for connecting tubing to flanges and threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Cast bronze threaded fittings must conform to ASME B16.15. Grooved mechanical joints and fittings must be designed for not less than 125 psig service and must be the product of the same manufacturer. Grooved fitting and mechanical coupling housing must be ductile iron conforming to ASTM A536. Gaskets for use in grooved joints must be molded synthetic polymer of pressure responsive design and must conform to ASTM D2000 for circulating medium up to 230 degrees F. Grooved joints must conform to AWWA C606. Coupling nuts and bolts for use in grooved joints must be steel and must conform to ASTM A183.

2.2.9 Steel Flanges

Flanged fittings including flanges, bolts, nuts, bolt patterns., etc. must be in accordance with ASME B16.5 class 150 and must have the manufacturers trademark affixed in accordance with MSS SP-25. Flange material must conform to ASTM A105/A105M. Flanges for high temperature water systems must be serrated or raised-face type. Blind flange material must conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts must be high strength or intermediate strength with material

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

conforming to ASTM A193/A193M.

2.2.10 Pipe Threads

Pipe threads must conform to ASME B1.20.1.

2.2.11 Nipples

Nipples must conform to ASTM A733 or ASTM B687, standard weight.

2.2.12 Unions

Unions must conform to ASME B16.39, type to match adjacent piping.

2.2.13 Adapters

Adapters for copper tubing must be brass or bronze for soldered fittings.

2.2.14 Dielectric Waterways

Dielectric waterways must conform to the tensile strength and dimensional requirements specified in ASME B16.39. Waterways must have metal connections on both ends to match adjacent piping. Metal parts of dielectric waterways must be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Dielectric waterways must have temperature and pressure rating equal to or greater than that specified for the connecting piping. Dielectric waterways must be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges must meet the performance requirements described herein for dielectric waterways.

2.2.15 Grooved Mechanical Joints

Rigid grooved pipe joints may be provided in lieu of unions, welded, flanges or screwed piping connections at chilled water pumps and allied equipment, and on aboveground pipelines in serviceable locations, if the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints must incorporate an angle bolt pad design which maintains metal-to-metal contact with equal amount of pad offset of housings upon installation to insure positive rigid clamping of the pipe. Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications, will not be permitted. Rigid grooved pipe couplings must be used with grooved end pipes, fittings, valves and strainers. Rigid couplings must be designed for not less than 125 psi service and appropriate for static head plus the pumping head, and must provide a water-tight joint. Grooved fittings and couplings, and grooving tools must be provided from the same manufacturer. Segmentally welded elbows must not be used. Grooves must be prepared in accordance with the coupling manufacturer's latest published standards. Grooving must be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations. The Contracting Officer must be notified 24 hours in advance of test to demonstrate operator's capability, and the test must be performed at the work site, if practical, or at a site agreed upon. The operator must demonstrate the ability to properly adjust the grooving

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

tool, groove the pipe, and verify the groove dimensions in accordance with the coupling manufacturer's specifications.

2.2.16 Flexible Pipe Connectors

Flexible pipe connectors must be designed for 125 psi or 150 psi service as appropriate for the static head plus the system head, and 250 degrees F. Connectors must be installed where indicated. The flexible section must be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. Materials used and the configuration must be suitable for the pressure, vacuum, temperature, and circulating medium. The flexible section may have threaded, welded, soldered, flanged, grooved, or socket ends. Flanged assemblies must be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors must be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, must be provided when recommended by the manufacturer. Provide covers to protect the bellows where indicated.

2.3 MATERIALS AND ACCESSORIES

2.3.1 Iron and Steel Sheets

2.3.1.1 Galvanized Iron and Steel

Galvanized iron and steel must conform to ASTM A653/A653M, with general requirements conforming to ASTM A653/A653M. Gauge numbers specified are Manufacturer's Standard Gauge.

2.3.1.2 Uncoated (Black) Steel

Uncoated (black) steel must conform to ASTM A653/A653M, composition, condition, and finish best suited to the intended use. Gauge numbers specified refer to Manufacturer's Standard Gauge.

2.3.2 Solder

Solder must conform to ASTM B32. Solder and flux must be lead free. Solder flux must be liquid or paste form, non-corrosive and conform to ASTM B813.

2.3.3 Solder, Silver

Silver solder must conform to AWS A5.8/A5.8M.

2.3.4 Thermometers

Mercury must not be used in thermometers. 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, and thermometers must have rigid stems with straight, angular, or inclined pattern.

2.3.5 Gauges

Provide gauges conforming to ASME B40.100.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.3.6 Gaskets for Flanges

Composition gaskets must conform to ASME B16.21. Gaskets must be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. Gaskets must contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). NBR binder must be used for hydrocarbon service. Gaskets must be suitable for pressure and temperatures of piping system.

2.3.7 Polyethylene Tubing

Low-density virgin polyethylene must conform to ASTM D1248, Type I, Category 5, Class B or C.

2.3.8 Bellows-Type Joints

Joints must be flexible, guided expansion joints. Expansion element must be of stainless steel. Bellows-type expansion joints must be in accordance with the applicable requirements of EJMA Stds and ASME B31.1 with internal liners.

2.3.9 Expansion Joints

Expansion joints must provide for either single or double slip of connected pipes, as required or indicated, and for not less than the traverse indicated. Joints must be designed for hot water working pressure not less than 150 psig and must be in accordance with applicable requirements of EJMA Stds and ASME B31.1. Joints must be designed for packing injection under full line pressure. End connections must be flanged or beveled for welding as indicated. Provide joints with anchor base where required or indicated. Where adjoining pipe is carbon steel, the sliding slip must be seamless steel plated with a minimum of 2 mils of hard chrome conforming to ASTM B650. Joint components must be fabricated from material equivalent to that of the pipeline. Initial settings must be made in accordance with manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides must be installed as recommended by joint manufacturer, but in any case must not be more than 5 feet from expansion joint except for lines 4 inches or smaller, guides must be installed not more than 2 feet from the joint. Provide service outlets where indicated.

2.3.10 Flexible Ball Joints

Flexible ball joints must be constructed of alloys as appropriate for the service intended. Where so indicated, the ball joint must be designed for packing injection under full line pressure to contain leakage. Joint ends must be threaded (to 2 inches only), grooved, flanged or beveled for welding as indicated or required and must be capable of absorbing a minimum of 15-degree angular flex and 360-degree rotation. Balls and sockets must be of equivalent material as the adjoining pipeline. Exterior spherical surface of carbon steel balls must be plated with 2 mils of hard chrome conforming to ASTM B650. Ball type joints must be designed and constructed in accordance with ASME B31.1 and ASME BPVC SEC VIII D1, where applicable. Flanges where required must conform to ASME B16.5. Gaskets and compression seals must be compatible with the service intended.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.3.11 Pipe Hangers, Inserts, and Supports

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

2.4 COLD WATER CONNECTIONS

Connections must be provided which include consecutively in line a strainer, backflow prevention device, and water pressure regulator. The backflow prevention device must be provided as indicated and in compliance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.4.1 Strainers

Basket or Y-type strainers must be the same size as the pipelines in which they are installed. Strainer bodies must be rated for 125 pound service, with bottoms drilled and plugged. Bodies must have arrows cast on the sides to indicate the direction of flow. Each strainer must be equipped with a removable cover and sediment basket. Basket must not be less than 22 gauge and must have perforations to provide a net free area through the basket of at least four times that of the entering pipe.

2.4.2 Pressure Regulating Valve

Valve must be a type that will not stick nor allow pressure to build up on the low side. Valve must be set to maintain a terminal pressure approximately 5 psi in excess of the static head on the system and must operate within a 20 psi variation regardless of initial pressure and without objectionable noise under any condition of operation.

2.5 EXPANSION TANK

Pressurization system must include a replaceable diaphragm-type captive air expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. The only air in the system must be the permanent sealed-in air cushion contained in the diaphragm-type tank. Sizes must be as indicated. Expansion tank must be welded steel, constructed, tested and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 125 psig and precharged to the minimum operating pressure. Tank air chamber must be fitted with an air charging valve. Tank must be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations.

2.6 AIR SEPARATOR TANK

External air separation tank must be steel, constructed, tested, and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 125 psi. The capacity of the air separation tank indicated is minimum.

2.7 HEAT EXCHANGERS

Heat exchangers must be multiple pass shell and U-tube type or plate and frame type as indicated, to provide low temperature hot water for the heating system when supplied at the temperatures and pressures indicated. Temperature and pressure for plate and frame exchangers must not exceed 280 degrees F and 280 psig for medium temperature hot water, or 280 degrees F and 35 psig for steam. Temperature and pressure for shell and U-tube exchangers must not exceed 338 degrees F and 100 psig for steam.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

or 430 degrees F and 400 psig for high temperature hot water. Exchangers must be constructed in accordance with ASME BPVC SEC VIII D1 and certified with ASME stamp secured to unit. U-tube bundles must be completely removable for cleaning and tube replacement and must be free to expand with shell. Shells must be of seamless steel pipe or welded steel construction and tubes must be seamless tubing as specified below unless otherwise indicated. Tube connections to plates must be leakproof. Provide saddles or cradles to mount shell and U-tube exchangers. Frames of plate and frame type exchangers must be fabricated of carbon steel and finished with baked epoxy enamel. Design fouling factor must be 0.0009.

2.8 SYSTEM EQUIPMENT AND ACCESSORIES

2.8.1 Circulating Pumps

Pumps for hot water must be of the single-stage centrifugal type, electrically driven. Pumps must be supported on a concrete foundation. Pumps must be either integrally mounted with the motor or direct-connected by means of a flexible-shaft coupling on a cast iron, or steel sub-base. Pump housing must be of close grained cast iron. Shaft must be carbon or alloy steel, turned and ground. Shaft seal must be mechanical-seal or stuffing-box type. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve must be bronze. Bearings must be ball-, roller-, or oil-lubricated, bronze-sleeve type, and must be sealed or isolated to prevent loss of oil or entrance of dirt or water. Motor must be of a type approved by the manufacturer of the pump.

2.8.2 Pressure Gauges and Thermometers

Provide gauges for each heat exchanger and piping as indicated. Provide a thermometer and pressure gauge on the high temperature water supply and return mains. Thermometers must be separable socket type.

2.8.3 Vacuum Relief Valve

Install a vacuum relief valve on the shell of each shell and U-tube steam heat exchanger and on the factory supplied steam inlet nozzle of each plate and frame heat exchanger. On shutoff of steam supply and condensing of steam, the vacuum relief valve must automatically admit air to the heat exchanger.

2.8.4 Pressure Relief Valves

Provide one or more pressure relief valves for each heat exchanger in accordance with ASME BPVC SEC VIII D1. The aggregate relieving capacity of the relief valves must be not less than that required by the above code. Discharge from the valves must be installed as indicated. Pressure relief valves for steam heat exchangers must be located on the low temperature water supply coming from near the heat exchanger as indicated. Relief valves for high temperature water heat exchanger must be installed on the heat exchanger shell.

2.8.5 Drains

Install a drain connection with 3/4 inch hose bib at the lowest point in the low temperature water return main near the heat exchanger. In addition, install threaded drain connections with threaded cap or plug wherever required for thorough draining of the low temperature water system.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.8.6 Strainers

Basket or Y-type strainer-body connections must be the same size as the pipe lines in which the connections are installed. The bodies must have arrows clearly cast on the sides to indicate the direction of flow. Each strainer must be equipped with an easily removable cover and sediment basket. The body or bottom opening must be equipped with nipple and gate valve for blowdown. The basket for steam systems must be of not less than 0.025 inch thick stainless steel, or monel with small perforations of sufficient number to provide a net free area through the basket of at least 2.5 times that of the entering pipe. The flow must be into the basket and out through the perforations.

2.9 INSULATION

Shop and field applied insulation must be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.10 FACTORY PAINTED EXPOSED SPACE HEATING EQUIPMENT

Radiator and convector enclosures must be coated with the manufacturer's standard rust inhibiting primer for painting in the field as specified in Section 09 90 00 PAINTS AND COATINGS. All other exposed heating equipment must be painted at the factory with the manufacturer's standard primer and enamel finish.

2.11 UNIT HEATERS

Heaters must be as specified below, and must have a heating capacity not in excess of 125 percent of the capacity indicated.

2.11.1 Propeller Fan Heaters

Heaters must be designed for suspension and arranged for vertical discharge of air as indicated. Casings must be not less than 20 gauge black steel and finished with lacquer or enamel. Suitable stationary deflectors must be provided to assure proper air and heat penetration capacity at floor level based on established design temperature. Suspension from heating pipes will not be permitted. Fans for vertical discharge type heaters must operate at speeds not in excess of 1,200 rpm, except that units with 80,000 Btu output capacity or less may operate at speeds up to 1,800 rpm.

2.11.2 Heating Elements

Heating coils must be as specified in Section 23 30 00 HVAC AIR DISTRIBUTION for types indicated. Coils must be suitable for use with water up to 250 degrees F.

2.11.3 Motors

Provide motors with NEMA 250 general purpose enclosure. Motors and motor controls must otherwise be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.11.4 Motor Switches

Provide motors with manual selection switches with "Off," and "Automatic"

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

positions and must be equipped with thermal overload protection.

2.11.5 Controls

Provide controls as specified in 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

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

Install all work as indicated and in accordance with the manufacturer's diagrams and recommendations.

3.3 COLOR CODE MARKING AND FIELD PAINTING

Color code marking, field painting of exposed pipe, and field painting of factory primed equipment must be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.4 WELDING

Submit 3 copies of qualified procedures and list of names and identification symbols of qualified welders and welding operators, prior to welding operations. Piping must be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders must be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer must be notified 24 hours in advance of tests and the tests must be performed at the work site if practical. The welder or welding operator must apply his assigned symbol near each weld he makes as a permanent record. Structural members must be welded in accordance with Section 05 05 23.16 STRUCTURAL WELDING. Welding and nondestructive testing procedures for piping must be as specified in Section 40 05 13.96 WELDING, PRESSURE PIPING.

3.5 PIPING

Unless otherwise specified, pipe and fittings installation must conform to the requirements of ASME B31.1. Pipe must be cut accurately to measurements established at the job site and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cuttings or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing must be cut square, must have burrs removed by reaming, and must be so installed as to permit free expansion and contraction without causing damage to building structure, pipe, joints, or hangers. Changes in direction must be made with factory made fittings, except that bending of pipe up to 4 inches will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center line radius of bends must not be less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

be accepted. Vent pipes must be installed through the roof as indicated and must be flashed as specified. Horizontal mains must pitch up or down in the direction of flow as indicated. The grade must be not less than 1 inch in 40 feet. Reducing fittings must be used for changes in pipe sizes. Open ends of pipelines and equipment must be capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified must be uncoated. Unions and other components for copper pipe or tubing must be brass or bronze. Connections between ferrous and copper piping must be electrically isolated using dielectric unions.

3.5.1 Joints

Except as otherwise specified, joints used on steel pipe must be threaded for fittings 1 inch and smaller; threaded or welded for 1-1/4 inches up through 2-1/2 inches; and flanged or welded for 3 inches and larger. Joints between sections of copper tubing or copper pipe must be flared or sweated. Pipe and fittings 1-1/4 inches and larger installed in inaccessible conduits or trenches beneath concrete floor slabs must be welded. Unless otherwise specified, connections to equipment must be made with black malleable iron unions for pipe 2-1/2 inches or smaller in diameter, and with flanges for pipe 3 inches or larger in diameter.

3.5.2 Low Temperature Systems

Piping may have threaded, welded, flanged or flared, sweated, or grooved mechanical joints as applicable and as specified. Reducing fittings must be used for changes in pipe sizes. In horizontal lines, reducing fittings must be the eccentric type to maintain the top of the adjoining pipes at the same level.

3.5.3 Steam Systems

Piping may have threaded, welded, or flanged joints as applicable and as specified. Reducing fittings must be used for changes in pipe sizes. In horizontal steam lines, reducing fittings must be the eccentric type to maintain the bottom of the lines at the same level. Grooved mechanical joints must not be used.

3.5.4 High And Medium Temperature Systems

Temperature systems must have welded joints to the maximum extent practicable, except screwed joints and fittings may be used at connections to equipment and on piping 2-1/2 inches and smaller. Equipment connections 3 inches and larger must be flanged. Piping connections 3 inches and larger may be welded or flanged. In horizontal lines, reducing fittings must be the eccentric type to maintain the tops of adjoining pipes at the same level. Grooved mechanical joints must not be used.

3.5.5 Threaded Joints

Threaded joints must be made with tapered threads properly cut, and must be made tight with PTFE tape complying with ASTM D3308, or equivalent thread joint compound applied to the male threads only, and in no case to the fittings.

3.5.6 Welded Joints

Joints must be fusion-welded unless otherwise required. Changes in

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

direction of piping must be made with welding fittings only. Branch connection may be made with either welding tees or branch outlet fittings. Branch outlet fittings must be forged, flared for improvement of flow where attached to the run, and reinforced against external strains.

3.5.7 Flanged Joints or Unions

Provide flanged joints or unions in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and similar items. Flanged joints must be faced true, provided with gaskets, and made square and tight. Full-faced gaskets must be used with cast iron flanges.

3.5.8 Flared and Sweated Pipe and Tubing

Pipe and tubing must be cut square and burrs must be removed. Both inside of fittings and outside of tubing must be cleaned with an abrasive before sweating. Care must be taken to prevent annealing of fittings and hard drawn tubing when making connection. Installation must be made in accordance with the manufacturer's recommendations. Changes in direction of piping must be made with flared or soldered fittings only. Solder and flux must be lead free. Joints for soldered fittings must be made with silver solder or 95:5 tin-antimony solder. Cored solder must not be used. Joints for flared fittings must be of the compression pattern. Provide swing joints or offsets on all branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing.

3.5.9 Mechanical Tee Joint

An extracted mechanical tee joint may be made in copper tube. Joint must be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. The branch tube must be notched for proper penetration into fitting to assure a free flow joint. Joints must be brazed in accordance with NAPHCC NSPC. Soldered joints will not be permitted.

3.5.10 Grooved Joints for Copper Tube

Grooves must be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools must be products of the same manufacturer. 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. Grooved joints must not be used in concealed locations.

3.6 CONNECTIONS TO EQUIPMENT

Provide supply and return connections unless otherwise indicated. Valves and traps must be installed in accordance with the manufacturer's recommendations. Unless otherwise indicated, the size of the supply and return pipes to each piece of equipment must be not smaller than the

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

connections on the equipment. Bushed connections are not permitted. Change in sizes must be made with reducers or increasers only.

3.6.1 Low Temperature Water and Steam and Return Connections

Connections, unless otherwise indicated, must be made with malleable iron unions for piping 2-1/2 inches or less in diameter and with flanges for pipe 3 inches or more in diameter.

3.6.2 High And Medium Temperature Water Connections

Connections must be made with 2000 pound black malleable iron unions for pipe 3/4 inch or less in diameter and with flanges for pipe 1 inch and larger in diameter.

3.7 BRANCH CONNECTIONS

Branches must pitch up or down as indicated, unless otherwise specified. Connection must be made to insure unrestricted circulation, eliminate air pockets, and permit drainage of the system.

3.7.1 Low Temperature Water Branches

Branches taken from mains must pitch with a grade of not less than 1 inch in 10 feet. Special flow fittings must be installed on the mains to bypass portions of water through each radiator. Special flow fittings must be installed as recommended by the manufacturer.

3.7.2 Steam Supply and Condensate Branches

Branches taken from mains must pitch with a grade of not less than 1 inch in 10 feet, unless otherwise indicated.

3.7.3 High And Medium Temperature Water Branches

Branches must take off at 45 degrees in the direction of the fluid flow from the supply and return lines and should be branched from the top or upper half of the main line unless otherwise indicated. Abrupt reduction in pipe sizes must be avoided.

3.8 RISERS

The location of risers is approximate. Exact locations of the risers must be as approved.

3.9 SUPPORTS

3.9.1 General

Hangers used to support piping 2 inches and larger must be fabricated to permit adequate adjustment after erection while supporting the load. Pipe guides and anchors must be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. All piping subjected to vertical movement when operating temperatures exceed ambient temperatures, must be supported by variable spring hangers and supports or by constant support hangers. Where threaded rods are used for support, they must not be formed or bent.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.9.1.1 Seismic Requirements for Pipe Supports, Standard Bracing

All piping and attached valves must be supported and braced to resist seismic loads as specified under UFC 3-301-01 and Sections 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS and 23 05 48.19 SEISMIC BRACING FOR MECHANICAL SYSTEMS . Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown must be provided under this section. Material used for supports must be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.9.1.2 Structural Attachments

Structural steel brackets required to support piping, headers, and equipment, but not shown, must be provided under this section. Material and installation must be as specified under Section 05 12 00 STRUCTURAL STEEL. Pipe hanger loads suspended from steel joist panel points must not exceed 50 pounds. Loads exceeding 50 pounds must be suspended from panel points.

3.9.1.3 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp must be used where each pipe crosses the base support member. Spacing of the base support members must not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run.

3.9.2 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts and supports must conform to MSS SP-58, except as specified as follows:

3.9.2.1 Types 5, 12, and 26

Use of these types is prohibited.

3.9.2.2 Type 3

Type 3 is prohibited on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe and if the clamp bottom does not extend through the insulation and the top clamp attachment does not contact the insulation during pipe movement.

3.9.2.3 Type 18 Inserts

Type 18 inserts must 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.

3.9.2.4 Type 19 and 23 C-Clamps

Type 19 and 23 C-clamps must be torqued in accordance with MSS SP-58 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

3.9.2.5 Type 20 Attachments

Provide Type 20 attachments used on angles and channels with an added malleable iron heel plate or adapter.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.9.2.6 Type 24

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

3.9.2.7 Type 39 Saddle or Type 40 Shield

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle must be used on all pipe 4 inches and larger.

3.9.2.8 Horizontal Pipe Supports

Space horizontal pipe supports as specified in MSS SP-58 and install a support not over 1 foot from the pipe fitting joint at each change in direction of the piping. Do not space pipe supports over 5 feet apart at valves.

3.9.2.9 Vertical Pipe Supports

Support vertical pipe at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, except support pipe not more than 8 feet from end of risers, and at vent terminations.

3.9.2.10 Type 35 Guides

Provide Type 35 guides using steel, reinforced PTFE or graphite slides where required to allow longitudinal pipe movement. Provide lateral restraints as required. Slide materials must be suitable for the system operating temperatures, atmospheric conditions and bearing loads encountered. Where steel slides do not require provision for restraint or lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate. Where there are high system temperatures and welding to piping is not desirable, then the Type 35 guide must include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe must be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

3.9.2.11 Pipe Hanger Size

Except for Type 3, pipe hangers on horizontal insulated pipe must be the size of the outside diameter of the insulation.

3.9.3 Piping in Trenches

Support piping as indicated.

3.10 PIPE SLEEVES

3.10.1 Pipe Passing Through Concrete or Masonry

Provide pipe passing through concrete or masonry walls or concrete floors or roofs with pipe sleeves fitted into place at the time of construction. Sleeves must not be installed in structural members except where indicated or approved. Rectangular and square openings must be as detailed. Each sleeve must extend through its respective wall, floor, or roof, and must

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

be cut flush with each surface. Unless otherwise indicated, sleeves must provide a minimum of 1/4 inch annular space between bare pipe or insulation surface and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas must be steel pipe or cast iron pipe. Sleeves in nonbearing walls, floors, or ceilings may be steel pipe, cast iron pipe, or galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve in nonfire rated walls and floors must be sealed as indicated and specified in Section 07 92 00 JOINT SEALANTS. Seal penetrations in fire walls and floors in accordance with Section 07 84 00 FIRESTOPPING.

3.10.2 Pipes Passing Through Waterproofing Membranes

Install pipes passing through waterproofing membranes through a 4 pound lead-flashing sleeve, a 16 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each having an integral skirt or flange. Flashing sleeve must be suitably formed, and the skirt or flange must extend 8 inches or more from the pipe and must be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve must extend up the pipe a minimum of 2 inches above the highest flood level of the roof or a minimum of 10 inches above the roof, whichever is greater, or 10 inches above the floor. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation must be sealed as indicated. At the Contractor's option, pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane must be clamped into place and sealant must be placed in the caulking recess.

3.10.3 Mechanical Seal Assembly

In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. The seals must consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. The links must be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolts must cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly must be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals must provide sleeves of the proper diameters.

3.10.4 Counterflashing Alternate

As an alternate to caulking and sealing the annular space between the pipe and flashing sleeve or metal-jacket-covered insulation and flashing sleeve, counterflashing may be by standard roof coupling for threaded pipe up to 6 inches in diameter; lead-flashing sleeve for dry vents and turning the sleeve down into the pipe to form a waterproof joint; or tack-welded or banded-metal rain shield round the pipe and sealing as indicated.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.10.5 Waterproofing Clamping Flange

Pipe passing through wall waterproofing membrane must be sleeved as specified. In addition, a waterproofing clamping flange must be installed as indicated.

3.10.6 Fire Seal

Where pipes pass through fire walls, fire partitions, fire rated pipe chase walls or floors above grade, provide a fire seal as specified in Section 07 84 00 FIRESTOPPING.

3.10.7 Escutcheons

Provide escutcheons at all finished surfaces where exposed piping, bare or covered, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons must be fastened securely to pipe sleeves or to extensions of sleeves without any part of sleeves being visible. Where sleeves project slightly from floors, special deep-type escutcheons must be used. Escutcheons must be chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrew.

3.11 ANCHORS

Provide anchors where necessary or indicated to localize expansion or prevent undue strain on piping. Anchors must consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces must be installed using turnbuckles where required. Supports, anchors, or stays must not be attached in places where construction will be damaged by installation operations or by the weight or expansion of the pipeline.

3.12 PIPE EXPANSION

The expansion of supply and return pipes must be provided for by changes in the direction of the run of pipe, by expansion loops, or by expansion joints as indicated. Low temperature water and steam expansion joints may be one of the types specified. Medium temperature water system expansion joints may be one of the joints specified, except slip-tube type.

3.12.1 Expansion Loops

Expansion loops must provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.1. The loops must be cold-sprung and installed where indicated. Provide pipe guides as indicated.

3.12.2 Slip-Tube Joints

Slip-tube type expansion joints must be used for steam and low temperature water systems only and must be installed where indicated. The joints must provide for either single or double slip of the connected pipes as indicated and for the traverse indicated. The joints must be designed for a working temperature and pressure suitable for the application and in no case less than 175 psig. The joints must be in accordance with applicable requirements of EJMA Stds and ASME B31.1. End connections must be flanged. Provide anchor bases or support bases must be provided as indicated or required. Initial setting must be made in accordance with

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

the manufacturer's recommendations to allow for ambient temperature at time of installation. Pipe alignment guides must be installed as recommended by the joint manufacturer, but in any case must be not more than 5 feet from expansion joint, except in lines 4 inches or smaller where guides must be installed not more than 2 feet from the joint.

3.12.3 Bellows-Type Joint

Bellows-type joint design and installation must comply with EJMA Std standards. The joints must be designed for the working temperature and pressure suitable for the application and must be not less than 150 psig in any case.

3.12.4 Flexible Ball Joints

Flexible ball joints may be threaded (to 2 inches only), flanged, or welded end as required. The ball-type joint must be designed and constructed in accordance with the generally accepted engineering principle stated in ASME B31.1, and ASME BPVC SEC VIII D1, where applicable. Flanges must conform to the diameter and drilling of ASME B16.5. Molded gaskets furnished must be suitable for the service intended.

3.13 VALVES AND EQUIPMENT ACCESSORIES

3.13.1 Valves and Equipment

Install valves at the locations shown or specified, and where required for the proper functioning of the system as directed. Gate valves must be used unless otherwise indicated, specified, or directed. Valves must be installed with their stems horizontal to or above the main body of the valve. Valves used with ferrous piping must have threaded or flanged ends and sweat-type connections for copper tubing.

3.13.2 Gravity Flow-Control Valve

Install the valve to control the flow of water in the supply main near the heat exchanger. The valve must operate so that when the circulating pump starts, the increased pressure within the main will open the valve; when the pump stops, the valve will close. The valve must be constructed with a cast iron body and must be provided with a device whereby the valve can be opened manually to allow gravity circulation. The flow-control valve must be designed for the intended purpose, and must be installed as recommended by the manufacturer.

3.13.3 Thermometer Socket

Provide a thermometer well in each return line for each circuit in multicircuit systems.

3.13.4 Air Vents

Install vents where indicated, and on all high points and piping offsets where air can collect or pocket.

3.13.4.1 Water Air Vents

Medium temperature water air vents must be as indicated. Vent discharge lines must be double-valved with globe valves and must discharge into a

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

funnel drain.

3.13.4.2 Steam Air Vents

Steam air vents must be a quick-acting valve that continuously removes air. Valve must be constructed of corrosion-resisting metal, must be designed to withstand the maximum piping system pressure, and must automatically close tight to prevent escape of steam and condensate. Vent must be provided with a manual isolation valve. Provide a vent on the shell of each steam heat exchanger.

3.14 STEAM TRAPS

Install float Traps in the condensate line as indicated. Other steam traps must be installed where indicated.

3.15 UNIT HEATERS

Install unit heaters as indicated and in accordance with the manufacturer's instructions.

3.16 INSULATION

Thickness of insulation materials for piping and equipment and application must be in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.17 MANUFACTURER'S SERVICES

Provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified. The representative must supervise the installation, adjustment, and testing of the equipment.

3.18 TESTING AND CLEANING

Submit performance 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, upon completion and testing of the installed system. Indicate in each test report the final position of controls.

3.18.1 Pressure Testing

Notify the Contracting Officer 30 days before the tests are to be conducted. Perform the tests in the presence of the Contracting Officer. Furnish all instruments and personnel required for the tests. Electricity, steam, and water will be furnished by the Government. All test results must be accepted before thermal insulation is installed. The entire low temperature heating system, including heat exchanger, radiators and fittings, must be hydrostatically tested and proved tight under a pressure of 45 psig for a period of four hours.

3.18.2 Test of Backflow Prevention Assemblies

Test backflow prevention assemblies in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.18.3 Cleaning

After the hydrostatic and backflow prevention tests have been made and prior to the operating tests, the heat exchanger and piping must be thoroughly cleaned by filling the system with a solution of 1 pound of caustic soda or 1 pound of trisodium phosphate per 50 gallons of water. Observe the proper safety precautions in the handling and use of these chemicals. Heat the water to approximately 150 degrees F, and circulate the solution in the system for a period of 48 hours, then drain and flush the system thoroughly with fresh water. Wipe clean all equipment, and remove all traces of oil, dust, dirt, or paint spots. The Contractor will be responsible for maintaining the system in a clean condition until final acceptance. Lubricate bearings with oil or grease as recommended by the manufacturer.

3.19 FRAMED INSTRUCTIONS

Submit proposed diagrams, instructions, and other sheets, prior to posting. Show in the instructions wiring and control diagrams and complete layout of the entire system. The instructions must include, in typed form, condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation and procedures for safely starting and stopping the system. Post framed instructions, containing wiring and control diagrams under glass or in laminated plastic, where directed. Condensed operating instructions, prepared in typed form, must be framed as specified above and posted beside the diagrams. Post the framed instructions before acceptance testing of the system.

3.20 FIELD TRAINING

Provide a field training course for designated operating and maintenance staff members. Provide training for a total period of 8 hours of normal working time starting after the system is functionally complete but prior to final acceptance tests. Field training must cover all of the items contained in the approved Operation and Maintenance Manuals. Submit 6 copies of operation and 6 copies of maintenance manuals for the equipment furnished. One complete set, prior to performance testing and the remainder upon acceptance. Operating manuals must detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals must include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals must list routine maintenance procedures, water treatment procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals must include piping and equipment layout and simplified wiring and control diagrams of the system as installed. Provide manuals prior to the field training course.

3.21 TESTING, ADJUSTING AND BALANCING

Except as specified herein, testing, adjusting, and balancing must be in accordance with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 64 10

WATER CHILLERS, VAPOR COMPRESSION TYPE 05/25

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 550/590 I-P | (2023) Performance Rating Of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle |
| AHRI 575 | (2017; R 2020) Method of Measuring Machinery Sound Within an Equipment Space |
| AHRI 580 | (2014; R2022) Performance Rating of Non-condensable Gas Purge Equipment for Use with Low Pressure Centrifugal Liquid Chillers |

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

- | | |
|---------|--|
| ABMA 9 | (2015) Load Ratings and Fatigue Life for Ball Bearings |
| ABMA 11 | (2014; R 2020) Load Ratings and Fatigue Life for Roller Bearings |

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

- | | |
|---------------------|---|
| ANSI/ASHRAE 15 & 34 | (2022) ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants |
|---------------------|---|

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- | | |
|-----------------------|--|
| ASME BPVC SEC VIII D1 | (2023) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1 |
|-----------------------|--|

AMERICAN WELDING SOCIETY (AWS)

- | | |
|-----------|--|
| AWS Z49.1 | (2021) Safety in Welding, Cutting and Allied Processes |
|-----------|--|

ASTM INTERNATIONAL (ASTM)

- | | |
|-----------|---|
| ASTM A307 | (2023) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength |
|-----------|---|

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D520	(2000; R 2019) Zinc Dust Pigment
ASTM E84	(2024) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F104	(2011; R 2020) Standard Classification System for Nonmetallic Gasket Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2021) Motors and Generators
NEMA MG 10009	(2022) Energy Management Guide for Selection and Use of Single-Phase Motors

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82	Protection of Stratospheric Ozone
-----------	-----------------------------------

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 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-03 Product Data

Posted Instructions
Verification of Dimensions
System Performance Tests
Demonstrations
Refrigerant
Scroll Type Water Chiller

SD-06 Test Reports

Field Acceptance Testing
Water Chiller - Field Acceptance Test Report
Factory Tests
System Performance Tests

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Factory Test Schedule;

SD-07 Certificates

Refrigeration System;

Refrigeration Technician Certification

SD-08 Manufacturer's Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals;

Training Course Schedule;

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S

1.3 CERTIFICATIONS

1.3.1 Refrigeration Technician Certification

All technicians working on equipment that contain Class I or II 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 SAFETY REQUIREMENTS

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. Install safety devices so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation is the Contractor's responsibility. Any materials found to be damaged must be replaced at the Contractor's expense. During installation, piping and similar openings must be capped to keep out dirt and other foreign matter.

1.6 PROJECT REQUIREMENTS

1.6.1 Verification of Dimensions

The Contractor must become 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment must be standard Commercial cataloged products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. These products must have a two year record of satisfactory field service prior to bid opening. The two year record of service must include applications of equipment and materials under similar circumstances and of similar size. Products having less than a two year record of satisfactory field service is acceptable if a certified record of satisfactory field service for not less than 6000 hours can be shown. The 6000 hour service record must not include any manufacturer's prototype or factory testing. Satisfactory field service must have been completed by a product that has been, and presently is being sold or offered for sale on the commercial market through the following copyrighted means: advertisements, manufacturer's catalogs, or brochures.

2.2 MANUFACTURER'S STANDARD NAMEPLATES

Major equipment including chillers, compressors, compressor drivers, condensers, water coolers, receivers, refrigerant leak detectors, 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. Fix plates in prominent locations with nonferrous screws or bolts.

2.3 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 00 INTERIOR DISTRIBUTION SYSTEM. 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, must be provided. For packaged equipment, the manufacturer must provide controllers including the required monitors and timed restart.
- b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, electronically commutated motors, including motors that are part of a system, in accordance with NEMA MG 10009.
- 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.
- 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. Motors must be rated for continuous duty with the enclosure specified. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque must be capable of accelerating the connected load within 20 seconds with 80 percent of

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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. Motor enclosure type may be either TEAO or TEFC.

- e. Use adjustable frequency drives for all variable-speed motor applications. Provide variable frequency drives for motors as specified in Section 26 29 23 ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS.
- f. Provide inverter duty premium efficiency motors for use with variable frequency drives.

2.4 SELF-CONTAINED WATER CHILLER, VAPOR COMPRESSION TYPE

Unless necessary for delivery purposes, units must be assembled, leak-tested, charged (refrigerant), and adjusted at the factory. In lieu of delivery constraints, a chiller may be assembled, leak-tested, charged (refrigerant), and adjusted at the job site by a factory representative. Unit components delivered separately must be sealed and charged with a nitrogen holding charge. Unit assembly must be completed in strict accordance with manufacturer's recommendations. Parts weighing 50 pounds or more which must be removed for inspection, cleaning, or repair, such as motors, gear boxes, cylinder heads, casing tops, condenser, and cooler heads, must have lifting eyes or lugs. Chiller must include all customary auxiliaries deemed necessary by the manufacturer for safe, controlled, automatic operation of the equipment. Provide chiller with a single point wiring connection for incoming power supply, unless noted otherwise on the drawings. Chiller must operate within capacity range and speed recommended by the manufacturer. Chiller must operate at partial load conditions without increased vibration over normal vibration at full load, and must be capable of continuous operation down to the specified minimum capacity.

2.4.1 Scroll Type Water Chiller

Chiller must be certified for performance per AHRI 550/590 I-P. If specified performance is outside of the Application Rating Conditions of AHRI 550/590 I-P, Table 2 then the chiller's performance must be rated in accordance with AHRI 550/590 I-P. In addition, project specific performance data must be based on the project site elevation above sea level, and clearly noted as such on the submittal. Chiller must conform to ANSI/ASHRAE 15 & 34. As a minimum, chiller must include the following components as defined in paragraph CHILLER COMPONENTS.

- a. Refrigerant and oil
- b. Structural base
- c. Chiller refrigerant circuit per compressor
- d. Controls package
- e. Scroll, reciprocating, or rotary screw compressor
- f. Compressor driver, electric motor
- g. Compressor driver connection

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- h. Water cooler (evaporator)
- i. Air-cooled condenser coil
- j. Air-Source Economizer

2.4.2 Air-Source Heat Pump Type Water Chiller (Non-Reversible)

Chiller must be certified for performance per AHRI 550/590 I-P. If specified performance is outside of the Application Rating Conditions of AHRI 550/590 I-P, Table 2 then the chiller's performance must be rated in accordance with AHRI 550/590 I-P. In addition, project specific performance data must be based on the project site elevation above sea level, and clearly noted as such on the submittal. Chiller must perform heat pump functions such that, while producing chilled water, its air-cooled condenser system is used to generate heating hot water of capacity and temperature as noted on the drawings. Chiller must conform to ANSI/ASHRAE 15 & 34. As a minimum, chiller must include the following components as defined in paragraph CHILLER COMPONENTS.

- a. Scroll compressor(s)
- b. Refrigerant and oil
- c. Structural base
- d. Chiller refrigerant circuit per compressor
- e. Controls Package

Controls package must include self-contained DDC-based software to control the chiller's heat pump functions to generate chilled water and incidental hot water via its condenser system.

- f. Compressor driver
- g. Compressor driver connection
- h. Water cooler (evaporator)
- i. Air-cooled condenser coil
- j. Heat recovery condenser
- k. Receiver

2.5 NOT USED

2.6 CHILLER COMPONENTS

2.6.1 Refrigerant

Refrigerants must be one of the fluorocarbon gases. Refrigerants must have number designations and safety classifications in accordance with ANSI/ASHRAE 15 & 34. CFC-based refrigerants are prohibited. Refrigerants

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

must have an Ozone Depletion Potential (ODP) no greater than 0.0 and a maximum Global Warming Potential (GWP) of 700. Provide SDS sheets for all refrigerants.

2.6.2 Structural Base

Chiller and individual chiller components must be provided with a factory-mounted structural steel base (welded or bolted) or support legs. Chiller and individual chiller components must be isolated from the building structure by means of vibration isolators with published load ratings. Vibration isolators must have isolation characteristics as recommended by the manufacturer for the unit supplied and the service intended.

2.6.3 Chiller Refrigerant Circuit

Chiller refrigerant circuit must be completely piped and factory leak tested in accordance with ANSI/ASHRAE 15 & 34. Circuit must include as a minimum a combination filter and drier, combination sight glass and moisture indicator, an electronic or thermostatic expansion valve with external equalizer or float valve, charging ports, compressor service valves for field-serviceable compressors, and superheat adjustment.

2.6.4 Controls Package

Provide chillers with a complete factory-mounted, microprocessor based operating and safety control system. Controls package must contain as a minimum a digital display, an on-auto-off switch, motor starters, variable frequency motor controller, disconnect switches, power wiring, and control wiring. Controls package must provide operating controls, monitoring capabilities, programmable setpoints, safety controls, and UMCS interfaces as defined below.

2.6.4.1 Operating Controls

Chiller must be provided with the following adjustable operating controls as a minimum.

- a. Leaving chilled water temperature control
- b. Adjustable timer or automated controls to prevent a compressor from short cycling
- c. Automatic lead/lag controls (adjustable) for multi-compressor units
- d. Load limiting
- e. System capacity control to adjust the unit capacity in accordance with the system load and the programmable setpoints. Controls must automatically re-cycle the chiller on power interruption.
- f. Startup and head pressure controls for air-cooled condensers to allow system operation at all ambient temperatures down to 40 degrees F.
- g. Fan sequencing for air-cooled condenser

2.6.4.2 Monitoring Capabilities

During normal operations, the control system must be capable of monitoring

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

and displaying the following operating parameters. Access and operation of display must not require opening or removing any panels or doors.

- a. Entering and leaving chilled water temperatures
- b. Entering and leaving chilled water pressureChilled water flow
- c.
- d. Self diagnostic
- e. Operation status
- f. Operating hours
- g. Number of starts
- h. Compressor status (on or off)
- i. Compressor load (percent)
- j. Refrigerant discharge and suction pressures
- k. Magnetic bearing levitation status (if applicable)
- l. Magnetic bearing temperatures (if applicable)
- m. Oil pressure (if applicable)

2.6.4.3 Configurable Setpoints

The control system must be capable of being configured directly at the unit's interface panel. The programmable setpoints must include the following as a minimum:

- a. Leaving Chilled Water Temperature
- b. Leaving Condenser Water Temperature
- c. Time Clock/Calendar Date

2.6.4.4 Safety Controls with Manual Reset

Chiller must be provided with the following safety controls which automatically shutdown the chiller and which require manual reset.

- a. Low chilled water temperature protection
- b. High condenser refrigerant discharge pressure protection
- c. Low evaporator pressure protection
- d. Chilled water flow detection
- e. High motor winding temperature protection
- f. Low oil flow protection (if applicable)
- g. Magnetic bearing controller (MBC), Internal fault (if applicable)

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- h. MBC, High bearing temperature (if applicable)
- i. MBC, Communication fault (if applicable)
- j. MBC, Power supply fault (if applicable)
- k. Motor current overload and phase loss protection

2.6.4.5 Safety Controls with Automatic Reset

Chiller must be provided with the following safety controls which automatically shutdown the chiller and which provide automatic reset.

- a. Over/under voltage protection
- b. Chilled water flow interlock
- c. MBC, Vibration (if applicable)
- d. MBC, No levitation (if applicable)
- e. Phase reversal protection

2.6.4.6 Remote Alarm

During the initiation of a safety shutdown, a chiller's control system must be capable of activating a remote alarm bell. In coordination with the chiller, the Contractor must provide an alarm circuit (including transformer if applicable) and a minimum 4 inch diameter alarm bell. Alarm circuit must activate bell in the event of machine shutdown due to the chiller's monitoring of safety controls. The alarm bell must not sound for a chiller that uses low-pressure cutout as an operating control.

2.6.4.7 Utility Monitoring and Control System Interface

Provide a Utility Monitoring and Control System (UMCS) interface meeting the requirements of Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and the requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. The interface must provide all system operating conditions, capacity controls, and safety shutdown conditions as network points. In addition, the following points must be overridable via the network interface:

- a. Unit Start/Stop
- b. Leaving Chilled Water Temperature Setpoint

2.6.5 Compressor(s)

2.6.5.1 Scroll Compressor(s)

Compressors must be of the hermetically sealed design. Compressors must be mounted on vibration isolators to minimize vibration and noise. Rotating parts must be statically and dynamically balanced at the factory to minimize vibration. Lubrication system must be centrifugal pump type equipped with a means for determining oil level and an oil charging valve. Crankcase oil heater must be provided. Provide continuous compressor unloading to 10 percent of full-load capacity by way of

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

variable speed compressor motor controller or variable unloading of the scroll.

2.6.5.2 Rotary Screw Compressor(s)

Compressors must operate stably for indefinite time periods to at least 25 percent capacity reduction without gas bypass external to the compressor. Provision must be made to insure proper lubrication of bearings and shaft seals on shutdown with or without electric power supply. Rotary screw compressors must include:

- a. An open or hermetic, positive displacement, oil-injected design directly driven by the compressor driver. Allow access to internal compressor components for repairs, inspection, and replacement of parts.
- b. Rotors must be solid steel, possessing sufficient rigidity for proper operation.
- c. A maximum rotor operating speed no greater than 3600 RPM. Provide cast iron rotor housing.
- d. Casings of cast iron, precision machined for minimal clearance about periphery of rotors with minimal clearance at rotor tops and rotor ends.
- e. A lubrication system of the forced-feed type that provides oil at the proper pressure to all parts requiring lubrication.
- f. Bearing housing must be conservatively loaded and rated for an L(10) life of not less than 200,000 hours. Shaft main bearings of the sleeve type with heavy duty bushings or rolling element type in accordance with ABMA 9 or ABMA 11.
- g. A differential oil pressure or flow cutout to allow the compressor to operate only when the required oil pressure or flow is provided to the bearings.
- h. Use a Variable Frequency Drive (VFD) to modulate capacity modulation from 100 percent to 15 percent.
- i. An oil separator and oil return system to remove oil entrained in the refrigerant gas and automatically return the oil to the compressor.
- j. Crankcase oil heaters must be provided.

2.6.5.3 Centrifugal Compressor(s)

Centrifugal compressors may be either single or multistage, having dynamically balanced impellers, either direct or gear driven by the compressor driver. Impellers must be over-speed tested at 1.2 times the impeller-shaft speed. Impeller shaft must be steel with sufficient rigidity for proper operation at any required operating speed. Compressors must be capable of variable speed operation and may have either oil-free bearing drives or oil-lubricated bearing drives. Centrifugal compressors must include:

- a. Shaft main bearings that are either oil lubricated, oil free ceramic

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

or magnetic levitated. The oil lubricated bearings must be the rolling element type in accordance with ABMA 9 or ABMA 11, journal type with bronze or babbitt liners, or of the aluminum-alloy one-piece insert type. Oil lubricated or oil free ceramic bearings must be rated for an L(10) life of not less than 200,000 hours. Magnetic levitated main shaft bearings must be in accordance with ISO 14839-1, ISO 14839-2, ISO 14839-3, ISO 14839-4, and provided with radial and axial magnetic levitated bearings (combination permanent and electro magnets) to levitate the shaft thereby eliminating metal to metal contact and thus eliminating the need for oil. The active magnetic bearings must be equipped with an automatic vibration reduction and balancing system. Each bearing position must be sensed by position sensors and provide real time positioning of the rotor shaft, controlled by on-board digital electronics. In the event of a power failure, the magnetic bearings must remain in operation throughout the compressor coast-down using a reserve power supply. Provide mechanical bearings designed for emergency touchdowns, as a backup to the magnetic bearings.

- b. Casing of cast iron, aluminum, or steel plate with split sections gasketed and bolted or clamped together.
- c. Lubrication system of the forced-feed type that provides oil at the proper pressure to all parts requiring lubrication.
- d. Provisions to ensure proper lubrication of bearings and shaft seals prior to starting and upon stopping with or without electric power supply (if applicable). On units providing forced-feed lubrication prior to starting, a differential oil pressure cutout interlocked with the compressor starting equipment must allow the compressor to operate only when the required oil pressure is provided to the bearings (if applicable).
- e. Oil sump heaters controlled as recommended by the manufacturer.
- f. Temperature-or pressure-actuated pre-rotation vane, variable geometry diffuser or suction damper to provide automatic capacity modulation from 100 percent capacity to 25 percent capacity. If operation to 25 percent capacity cannot be achieved without providing gas bypass external to the compressor, then the Contractor must indicate in the equipment submittal the load percent at which external hot gas bypass is required to prevent surge and to provide the specified capacity reduction and its impact on performance.

2.6.6 Compressor Driver, Electric Motor

Components such as motors, starters, variable speed drives, and wiring must be in accordance with paragraph ELECTRICAL WORK. Variable frequency drive must be unit mounted as indicated with variable frequency drive type, wiring, and accessories coordinated with the chiller manufacturer.

2.6.7 NOT USED

2.6.7.1 Exhaust System Connections

Flexible connectors must be provided at the exhaust piping connection to the engine. An expansion joint must be provided in the exhaust piping at

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

the muffler connection. Flexible connectors and expansion joints must have flanged connections. Flexible sections must be made of convoluted seamless tube without joints or packing. Expansion joints must be the bellows type. Expansion and flexible elements must be stainless steel suitable for engine exhaust gas at 1200 degrees F. Flexible connectors and expansion joints must be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.6.8 NOT USED

2.6.9 NOT USED

2.6.10 Air-Cooled Condenser Coil

Condenser coil must be of the extended-surface fin-and-tube type and must be constructed of seamless copper or aluminum tubes with compatible copper or aluminum fins. Fins must be soldered or mechanically bonded to the tubes and installed in a metal casing. Coils must be circuited and sized for a minimum of 5 degrees F subcooling and full pump-down capacity. Coil must be factory leak and pressure tested after assembly in accordance with ANSI/ASHRAE 15 & 34.

2.6.11 NOT USED

2.6.12 NOT USED

2.6.13 Receivers

Receiver must bear a stamp certifying compliance with ASME BPVC SEC VIII D1 and must meet the requirements of ANSI/ASHRAE 15 & 34. Inner surfaces must be thoroughly cleaned by sandblasting or other approved means. Each receiver must have a storage capacity not less than 20 percent in excess of that required for the fully-charged system. Each receiver must be equipped with inlet, outlet drop pipe, drain plug, purging valve, relief valves of capacity and setting required by ANSI/ASHRAE 15 & 34, and two bull's eye liquid-level sight glasses. Sight glasses must be in the same vertical plane, 90 degrees apart, perpendicular to the axis of the receiver, and not over 3 inches horizontally from the drop pipe measured along the axis of the receiver. In lieu of bull's eye sight glass, external gauge glass with metal glass guard and automatic closing stop valves may be provided.

2.6.14 Chiller Purge System

Chillers which operate at pressures below atmospheric pressure must be provided with a purge system. Purge system must automatically remove air, water vapor, and non-condensable gases from the chiller's refrigerant while keeping refrigerant emissions below requirements of ASHRAE Std 147. Purge units must be certified per AHRI 580. Purge system must condense, separate, and return all refrigerant back to the chiller. An oil separator must be provided with the purge system if required by the manufacturer. Purge system must not discharge to occupied areas, or create a potential hazard to personnel. Purge system must include a purge pressure gauge, number of starts counter, and an elapsed time meter. Purge system must include lights or an alarm which indicate excessive

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

purge or an abnormal air leakage into chiller.

2.6.15 Tools

One complete set of special tools, as recommended by the manufacturer for field maintenance of the system, must be provided. Tools must be mounted on a tool board in the equipment room or contained in a toolbox as directed by the Contracting Officer.

2.7 ACCESSORIES

2.7.1 NOT USED

2.7.2 NOT USED

2.7.3 NOT USED

2.7.4 Gaskets

Gaskets must conform to ASTM F104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.7.5 Bolts and Nuts

Bolts and nuts, except as required for piping applications, must be in accordance with ASTM A307. The bolt head must be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A307.

2.8 FABRICATION

2.8.1 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 withstands 125 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.

2.8.2 Factory Applied Insulation

Chiller must be provided with factory installed insulation on surfaces subject to sweating including the water cooler, suction line piping, economizer, and cooling lines. Insulation on heads of coolers may be field applied, however it must be installed to provide easy removal and replacement of heads without damage to the insulation. Where motors are the gas-cooled type, factory installed insulation must be provided on the cold-gas inlet connection to the motor per manufacturer's standard practice. Factory insulated items installed outdoors are not required to

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

2.8.3 NOT USED

2.9 FACTORY TESTS

2.9.1 Chiller Performance Test

The Contractor and proposed chiller manufacturer must be responsible for performing the chiller factory test to validate the specified full load capacity, full load EER, and IPLV in accordance with AHRI 550/590 I-P except as indicated. The Contractor and chiller manufacturer must provide to the Government a certified chiller factory test report in accordance with AHRI 550/590 I-P to confirm that the chiller performs as specified. Tests must be conducted in an AHRI certified test facility in conformance with AHRI 550/590 I-P procedures and tolerances, except as indicated. At a minimum, chiller capacity must be validated to meet the scheduled requirements indicated on the drawings. Tolerance or deviation must be in strict accordance with AHRI 550/590 I-P. Stable operation at minimum load of 10 percent of total capacity must be demonstrated during the factory test.

2.9.1.1 Temperature Adjustments

Temperature adjustments must adhere to AHRI 550/590 I-P to adjust from the design fouling factor to the clean tube condition. Test temperature adjustments must be verified prior to testing by the manufacturer. There must be no exceptions to conducting the test with clean tubes with the temperature adjustments per AHRI 550/590 I-P. The manufacturer must clean the tubes prior to testing to obtain a test fouling factor of 0.0000.

2.9.1.2 Test Instrumentation

The factory test instrumentation must be per AHRI 550/590 I-P and the calibration must be traceable to the National Institute of Standards and Technology.

2.9.1.3 Equipment Adjustments

If the equipment fails to perform within allowable tolerances, the manufacturer must be allowed to make necessary revisions to his equipment and retest as required.

2.9.2 Chiller Sound Test

Chillers must be sound tested at the factory prior to shipment to confirm the sound pressure level specified herein. Tests and data must be

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

conducted and measured in strict accordance with AHRI 575 at the full load system operating conditions. The chiller sound pressure level, in decibels (dB), with a reference pressure of 20 micropascals, must not exceed 85 dB, A weighted. Ratings must be in accordance with AHRI 575. No reduction of entering condenser water temperature or raising of leaving chilled water temperature is allowed. A minimum of 75 percent of the sound data points must be taken along the length of the machine, and established as the minimum percentage of total possible points used to determine sound levels. In the event that the chiller does not meet the dBA sound pressure level, the manufacturer must, at his expense, provide sufficient attenuation to the machine to meet the specified value. This attenuation must be applied in such a manner that it does not hinder the operation or routine maintenance procedures of the chiller. The attenuation material, adhesives, coatings, and other accessories must have surface burning characteristics as determined by ASTM E84.

2.10 SUPPLEMENTAL COMPONENTS/SERVICES

2.10.1 Chilled and Condenser Water Piping and Accessories

Chilled and condenser water piping and accessories must be provided and installed in accordance with Section 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS.

2.10.2 Refrigerant Piping

Refrigerant piping for split-system water chillers must be provided and installed in accordance with Section 23 23 00 REFRIGERANT PIPING.

2.10.3 Cooling Tower

Cooling towers must be provided and installed in accordance with Section 23 65 00 COOLING TOWERS AND REMOTE EVAPORATIVELY-COOLED CONDENSERS.

2.10.4 Temperature Controls

Chiller control packages must be fully coordinated with and integrated into the temperature control system indicated in Section 23 30 00 HVAC AIR DISTRIBUTION and Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of water chiller systems including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing must be in accordance with the manufacturer's written installation instructions, including the following:

- (1) Water chiller - installation instructions

3.1.1 Installation Instructions

Provide manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show features such as materials, dimensions, options, performance and efficiency. Data must include manufacturer's recommended installation instructions, and start-up procedures and checklists. Data must be

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

adequate to demonstrate compliance with contract requirements.

All recommendations stated in the installation instructions or other similar manufacturer's published literature must be considered mandatory and part of the contract documents. Any discrepancies to the engineered drawings and specifications must be brought to the attention of the COR.

3.1.2 Vibration Isolation

If vibration isolation is specified for a unit, vibration isolator literature must be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

3.1.3 Posted Instructions

Provide posted instructions, 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.

3.1.4 Verification of Dimensions

Provide a letter including the date the site was visited, conformation of existing conditions, and any discrepancies found.

3.1.5 System Performance Test Schedules

Provide 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.

3.1.6 Certificates

Where the system, components, or equipment are specified to comply with requirements of AGA, NFPA, AHRI, ANSI/ASHRAE, ASME, or UL, proof of such compliance must be provided. The label or listing of the specified agency must be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard AHRI rating conditions, computer printouts, catalog, or other application data certified by AHRI or a nationally recognized laboratory as listed in this Certificates section must be included. If AHRI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

3.1.7 Operation and Maintenance Manuals

Provide six 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

least 4 weeks prior to the first 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. Six 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.

3.1.8 Connections to Existing Systems

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.1.9 Refrigeration System

3.1.9.1 Equipment

Refrigeration equipment and the installation thereof must conform to ANSI/ASHRAE 15 & 34. Necessary supports must be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, water coolers, and similar items. Compressors must be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations must be provided. Each foundation must include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment must be set on not less than a 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps must have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block must be of mass not less than three times the combined pump, motor, and base weights. Isolators must be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators must limit vibration to 20 percent at lowest equipment rpm. Lines connected to pumps mounted on pedestal blocks must be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts must be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations must be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Equipment must be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions. All recommendations stated in the installation instructions or other similar manufacturer's published literature must be considered mandatory and part of the contract documents. Any discrepancies to the engineered drawings and specifications must be brought to the attention of the COR.

3.1.9.2 Field Refrigerant Charging

- a. Initial Charge: Upon completion of all the refrigerant pipe tests, the vacuum on the system must be broken by adding the required charge of dry refrigerant for which the system is designed, in accordance

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

with the manufacturer's recommendations. Contractor must provide the complete charge of refrigerant in accordance with manufacturer's recommendations. Upon satisfactory completion of the system performance tests, any refrigerant that has been lost from the system must be replaced. After the system is fully operational, service valve seal caps and blanks over gauge points must be installed and tightened.

- b. Refrigerant Leakage: If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system must immediately be isolated from the remainder of the system and the refrigerant must be pumped into the system receiver or other suitable container. The refrigerant must not be discharged into the atmosphere.
- c. Contractor's Responsibility: The Contractor must, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps must include, but not be limited to, procedures that minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time must more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year must be repaired in accordance with the specified requirements including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.1.9.3 Oil Charging

Except for factory sealed units, two complete charges of lubricating oil for each compressor crankcase must be furnished. One charge must be used during the performance testing period, and upon the satisfactory completion of the tests, the oil must be drained and replaced with the second charge.

3.1.10 Mechanical Room Ventilation

Mechanical ventilation systems must be in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

3.1.11 Field Applied Insulation

Field installed insulation must be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.12 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FACTORY TEST SCHEDULING AND REPORTS

Provide Factory Test Schedule which identify the date, time, and location for each test. Schedules must be submitted for the Chiller Performance Tests and the Chiller Sound Test. The Chiller Performance Test schedule must also allow the witnessing of the test by a Government Representative.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Six copies of the certified test report must be forwarded to the Government for approval prior to project acceptance. Calibration curves and information sheets for all instrumentation must be included. Provide copies in bound 8 1/2 by 11 inch booklets. Reports must certify the compliance with performance requirements and follow the format of the required testing standard for the Chiller Performance Tests and the Chiller Sound Tests. Test report must include certified calibration report of all test instrumentation. Calibration report must include certification that all test instrumentation has been calibrated within 6 months prior to the test date, identification of all instrumentation, and certification that all instrumentation complies with requirements of the test standard. Test report must be submitted 1 week after completion of the factory test.

3.3 MANUFACTURER'S FIELD SERVICE

The services of a factory-trained representative must be provided for overseeing of the installation, start-up, and initial operation of the chiller including field acceptance testing. The representative must advise on the following:

a. Hermetic machines:

- (1) Testing hermetic water-chilling unit under pressure for refrigerant leaks; evacuation and dehydration of machine to an absolute pressure of not over 300 micrometers.
- (2) Charging the machine with refrigerant.
- (3) Starting the machine.

b. Open Machines:

- (1) Erection, alignment, testing, and dehydrating.
- (2) Charging the machine with refrigerant.
- (3) Starting the machine.

3.4 CLEANING AND ADJUSTING

Equipment must be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Provide temporary filters for all fans that are operated during construction. Perform and document that proper Indoor Air Quality During Construction procedures have been followed; this includes providing documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed. 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. At least one week before the official equipment warranty start date, all condenser coils on air-cooled water chillers and split-system water chillers must be cleaned in accordance with the chiller manufacturer's instructions. All recommendations stated in the installation instructions or other similar manufacturer's published literature must be considered mandatory and part of the contract documents. Any discrepancies to the engineered drawings

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

and specifications must be brought to the attention of the COR. This work covers two coil cleanings. The condenser coils must be cleaned with an approved coil cleaner by a service technician, factory trained by the chiller manufacturer. The condenser coil cleaner must not have any detrimental affect on the materials or protective coatings on the condenser coils. Testing, adjusting, and balancing must be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.5 FIELD ACCEPTANCE TESTING

3.5.1 Test Plans

- a. Manufacturer's Test Plans: Within 120 calendar days after contract award, submit the following plans:

- (1) Water chiller - Field Acceptance Test Plan

Field acceptance test plans must be developed by the chiller manufacturer detailing recommended field test procedures for that particular type and size of equipment. Field acceptance test plans developed by the installing Contractor, or the equipment sales agency furnishing the equipment, is not acceptable.

The Contracting Officer must review and approve the field acceptance test plan for each of the listed equipment prior to commencement of field testing of the equipment. The approved field acceptance tests of the chiller and subsequent test reporting.

- b. Coordinated testing: Indicate in each field acceptance test plan when work required by this section requires coordination with test work required by other specification sections. Furnish test procedures for the simultaneous or integrated testing of tower system controls which interlock and interface with controls for the equipment provided under Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.
 - c. Prerequisite testing: Chillers for which performance testing is dependent upon the completion of the work covered by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC must have that work completed as a prerequisite to testing work under this section. Indicate in each field acceptance test plan when such prerequisite work is required.
 - d. Test procedure: Indicate in each field acceptance test plan each equipment manufacturers published installation, start-up, and field acceptance test procedures. Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer.

Each test plan must include the required test reporting forms to be completed by the Contractor's testing representatives. Procedures must be structured to test the controls through all modes of control to confirm that the controls are performing with the intended sequence of control.

Controller must be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- e. Performance variables: Each test plan must list performance variables that are required to be measured or tested as part of the field test.

Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Chiller manufacturer must furnish with each test procedure a description of acceptable results that have been verified.

Chiller manufacturer must identify the acceptable limits or tolerance within which each tested performance variable must acceptably operate.

- f. Job specific: Each test plan must be job specific and must address the particular cooling towers and particular conditions which exist in this contract. Generic or general preprinted test procedures are not acceptable.
- g. Specialized components: Each test plan must include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

3.5.2 Testing

- a. Each water chiller system must be field acceptance tested in compliance with its approved field acceptance test plan and the resulting following field acceptance test report submitted for approval:
 - (1) Water chiller - Field Acceptance Test Report
- b. Manufacturer's recommended testing: Conduct the manufacturer's recommended field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field acceptance testing.
- c. Operational test: Conduct a continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed must result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every two hours. Use the test report forms for logging the operational variables.
- d. Notice of tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.
- e. Report forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment must be reviewed, approved, and signed by the Contractor's test director. The manufacturer's field test representative must review, approve, and sign the report of the manufacturer's recommended test. Signatures must be accompanied by the person's name typed.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- f. Deficiency resolution: The test requirements acceptably met; deficiencies identified during the tests must be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

3.6 SYSTEM PERFORMANCE TESTS

All reports must be signed and submitted in electronic format. In addition, six copies of the report must be provided in bound 8 1/2 by 11 inch booklets.

3.6.1 General Requirements

Before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment must be conducted by the manufacturer's approved start-up representative experienced in system start-up and testing, at such times as directed. 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. Corrections and adjustments must be made as necessary and tests must be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points must be installed and tightened. Any refrigerant lost during the system startup must be replaced. If tests do not demonstrate satisfactory system performance, deficiencies must be corrected and the system must be retested. Tests must be conducted in the presence of the Contracting Officer. Water and electricity required for the tests must be furnished by the Government. Any material, equipment, instruments, and personnel required for the test must be provided by the Contractor. Field tests must be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.6.2 Test Report

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. The report must also include the following information and must be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

- a. Date and outside weather conditions.
- b. The load on the system based on the following:
 - (1) The refrigerant used in the system.
 - (2) Condensing temperature and pressure.
 - (3) Suction temperature and pressure.
 - (4) Running current, voltage and proper phase sequence for each phase of all motors.
 - (5) The actual on-site setting of all operating and safety controls.
 - (6) Chilled water pressure, flow and temperature in and out of the chiller.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- (7) The position of the capacity-reduction gear at machine off, one-third loaded, one-half loaded, two-thirds loaded, and fully loaded.

3.7 DEMONSTRATIONS

Contractor must conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of a total 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The training course must cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

Provide a Training Course Schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 23 64 26

CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS

08/09, CHG 7: 02/24

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4 (2015; R 2020) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
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 B16.9	(2024) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2022) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2021) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
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 B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B31.9	(2020) Building Services Piping
ASME B40.100	(2022) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Qualifications

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1003	(2020) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
ASSE 1017	(2023) Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems - (ANSI approved 2010)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(2022) Grooved and Shouldered Joints
-----------	--------------------------------------

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS BRH	(2007; 5th Ed) Brazing Handbook
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
AWS Z49.1	(2021) Safety in Welding, Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M	(1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M	(2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A536	(2024) Standard Specification for Ductile Iron Castings
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A733	(2016; R 2022) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B42	(2020) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B813	(2024) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM D520	(2000; R 2019) Zinc Dust Pigment
ASTM D1384	(2005; R 2019) Corrosion Test for Engine Coolants in Glassware
ASTM D2000	(2018; R 2024) Standard Classification System for Rubber Products in Automotive Applications
ASTM D3308	(2012; R 2017) Standard Specification for PTFE Resin Skived Tape
ASTM E84	(2024) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F1007	(2018; R 2022) Standard Specification for Pipeline Expansion Joints of the Packed Slip Type for Marine Application
ASTM F1120	(1987; R 2024) Standard Specification for Circular Metallic Bellows Type Expansion Joints for Piping Applications
ASTM F1199	(2021) Standard Specification for Cast (All Temperatures and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)
ASTM F2389	(2024a) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA Stds	(2015) (10th Ed) EJMA Standards
-----------	---------------------------------

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.2 (2014) Rotodynamic (Centrifugal) Pump for
Nomenclature and Definitions

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-67 (2022) Butterfly Valves

MSS SP-70 (2011) Gray Iron Gate Valves, Flanged and
Threaded Ends

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

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

MSS SP-80 (2019) Bronze Gate, Globe, Angle and Check
Valves

MSS SP-85 (2011) Gray Iron Globe & Angle Valves
Flanged and Threaded Ends

MSS SP-110 (2010) Ball Valves Threaded,
Socket-Welding, Solder Joint, Grooved and
Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

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

NEMA MG 1 (2021) Motors and Generators

NEMA MG 11 (1977; R 2012) Energy Management Guide for
Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2024) Standard for the Installation of
Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF/ANSI 14 (2023) Plastics Piping System Components
and Related Materials

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.2 SYSTEM DESCRIPTION

Provide the water systems having the minimum service (design) temperature-pressure rating indicated. Provision of the piping systems, including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the required and advisory provisions of ASME B31.9 except as modified or supplemented by this specification section or design drawings. This specification section covers the water systems piping which is located within, on, and adjacent to building(s) within the building(s) 5 foot line.

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 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-03 Product Data

- Grooved Mechanical Connections For Steel;
- Grooved Mechanical Connections For Copper;
- Calibrated Balancing Valves;
- Automatic Flow Control Valves;
- Water Temperature Mixing Valve;
- Water Temperature Regulating Valves;
- Water Pressure Reducing Valve
- Pressure Relief Valve
- Combination Pressure and Temperature Relief Valves
- Expansion Joints;
- Pumps;
- Combination Strainer and Pump Suction Diffuser
- Expansion Tanks
- Air Separator Tanks
- Water Treatment Systems;

Proposed water treatment plan including a layout, control scheme, a list of existing make-up water conditions including the items listed in paragraph WATER ANALYSIS, a list of chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SD-06 Test Reports

Piping Welds NDE Report

Pressure Tests Reports;

Report shall be provided in bound 8-1/2 by 11 inch booklets. In the reports, document all phases of the tests performed. Include initial test summaries, all repairs/adjustments made, and the final test results.

Condenser Water Quality Test Reports;

Test reports, each month for a period of one year after project completion, in bound 8-1/2 by 11 inch booklets. In the reports, identify the chemical composition of the condenser water. Also include the comparison of the manufacturer's recommended operating conditions for the cooling tower and condenser in relation to the condition of the condenser water. Document in the report any required corrective action taken.

One-Year Inspection Report For Cooling Water;

At the completion of one year of service, in bound 8-1/2 by 11 inch booklets. In the report, identify the condition of each cooling tower and condenser. Include a comparison of the condition of the cooling tower and condenser with the manufacturer's recommended operating conditions. Identify all actions taken by the Contractor and manufacturer to correct deficiencies during the first year of service.

SD-07 Certificates

Employer's Record Documents (For Welding)

Welding Procedures and Qualifications

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Piping for Steam and Condensate

Piping for High-Pressure Compressed-Air Systems

Fittings

Unions

Flanges

Gaskets

Bolting

SD-08 Manufacturer's Instructions

Lesson plan for the Instruction Course;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SD-10 Operation and Maintenance Data

Requirements for data packages are specified Section 01 78 23 OPERATION AND MAINTENANCE DATA, except as supplemented and modified by this specification section.

Submit spare parts data for each different item of equipment specified, with operation and maintenance data packages. Include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for one year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

Submit a list of qualified permanent service organizations with operation and maintenance data packages. Include service organization addresses and service area or expertise. The service organizations shall 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.

Water Treatment Systems;

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. Include testing procedures used in determining water quality.

A maintenance manual in bound 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide.

Calibrated Balancing Valves, Data Package 3;

Automatic Flow Control Valves, Data Package 3;

Water Temperature Mixing Valve, Data Package 3;

Water Temperature Regulating Valves, Data Package 3;

Water Pressure Reducing Valve, Data Package 3;

Pressure Relief Valve, Data Package 2;

Combination Pressure and Temperature Relief Valves, Data Package 2;

Expansion Joints, Data Package 2;

Pumps, Data Package 3;

Combination Strainer and Pump Suction Diffuser, Data Package 2;

Expansion Tanks, Data Package 2;

Air Separator Tanks, Data Package 2;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4 MODIFICATIONS TO 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.

1.4.1 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."

1.4.2 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.

1.5 SAFETY REQUIREMENTS

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 shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter. Any porous materials found to be contaminated with mold or mildew will be replaced at the Contractor's expense. Non-porous materials found to be contaminated with mold or mildew will be disinfected and cleaned prior to installation.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

The Contractor shall become 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.7.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.7.3 Accessibility

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 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be 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 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 2 years experience shall 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 shall 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. System components shall be environmentally suitable for the indicated locations.

The equipment items shall be supported by service organizations. 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.

2.2 STEEL PIPING

Water piping shall be steel pipe or copper tubing. Provide steel piping with a ANSI/ASME Class 125 service rating, which for 150 degrees F, the pressure rating is 175 psig.

2.2.1 Pipe

Steel pipe, conform to ASTM A53/A53M, Schedule 40, Type E or S, Grades A or B. Do not use Type F pipe.

2.2.2 Fittings and End Connections (Joints)

Piping and fittings 1 inch and smaller shall have threaded connections. Piping and fittings larger than 1 inch and smaller than 3 inches shall have either threaded, grooved, or welded connections. Piping and fittings

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3 inches and larger shall have grooved, welded, or flanged connections. The manufacturer of each fitting shall be permanently identified on the body of the fitting in accordance with MSS SP-25.

2.2.2.1 Threaded Connections

Use threaded valves and pipe connections conforming to ASME B1.20.1. Use threaded fitting conforming to ASME B16.3. Use threaded unions conforming to ASME B16.39. Use threaded pipe nipples conforming to ASTM A733.

2.2.2.2 Flanged Connections

Flanges shall conform to ASME B16.1, Class 125. Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. These gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.1.

2.2.2.3 Welded Connections

Welded valves and pipe connections (both butt-welds and socket-welds types) shall conform to ASME B31.9. Butt-welded fittings shall conform to ASME B16.9. Socket-welded fittings shall conform to ASME B16.11. Welded fittings shall be identified with the appropriate grade and marking symbol.

2.2.2.4 Grooved Mechanical Connections For Steel

Rigid grooved mechanical connections may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved connections shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein.

Each grooved mechanical joint shall be a system, including coupling housing, gasket, fasteners, all furnished by the same manufacturer. Joint installation shall be in compliance with joint manufacturer's written instructions.

Use fitting and coupling houses of malleable iron conforming to ASTM A47/A47M, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12; or steel conforming to ASTM A106/A106M, Grade B or ASTM A53/A53M. Use gaskets of molded synthetic rubber with central cavity, pressure responsive configuration and conforming to ASTM D2000 Grade No. 2CA615A15B44F17Z for circulating medium up to 230 degrees F or Grade No. M3BA610A15B44Z for circulating medium up to 200 degrees F. Grooved mechanical connections shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A183. Pipe connections and fittings shall be the product of the same manufacturer. Provide joint installation be in compliance with joint manufacturer's written instructions.

2.2.2.5 Dielectric Waterways and Flanges

Provide dielectric waterways with a water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

be able to withstand a 600-volt breakdown test. Provide dielectric waterways constructed of galvanized steel and have threaded end connections to match connecting piping. Dielectric waterways shall be suitable for the required operating pressures and temperatures. Provide dielectric flanges with the same pressure ratings as standard flanges and provide complete electrical isolation between connecting pipe and/or equipment as described herein for dielectric waterways.

2.3 POLYPROPYLENE PIPING (CHILLED WATER APPLICATIONS ONLY)

2.3.1 Pipe

Polypropylene pipe shall be Schedule 40, copolymer, and shall meet ASTM F2389 and NSF/ANSI 14.

2.3.2 Fittings

Fittings shall meet ASTM F2389 and NSF/ANSI 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement shall bear the NSF seal "NSF-PW."

Polypropylene fittings shall conform to dimensional requirements of Schedule 40. Polypropylene piping that will be exposed to UV light shall be provided with a Factory applied UV resistant coating.

2.4 NOT USED

2.5 NOT USED

2.6 COPPER TUBING

Provide copper tubing and fittings with a ANSI/ASME Class 125 service rating, which for 150 degrees F., the pressure rating is 175 psig.

2.6.1 Tube

Use copper tube conforming to ASTM B88, Type L or M for aboveground tubing, and Type K for buried tubing.

2.6.2 Fittings and End Connections (Solder and Flared Joints)

Wrought copper and bronze solder joint pressure fittings, including unions and flanges, shall conform to ASME B16.22 and ASTM B75/B75M. Provide adapters as required. Cast copper alloy solder-joint pressure fittings, including unions and flanges, shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B62. ASTM B42 copper pipe nipples with threaded end connections shall conform to ASTM B42.

Copper tubing of sizes larger than 4 inches shall have brazed joints. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

Extracted brazed tee joints may be used if produced with an acceptable tool and installed in accordance with tool manufacturer's written procedures.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.6.3 Grooved Mechanical Connections For Copper

Rigid grooved mechanical connections may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved connections shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein.

Each grooved mechanical joint shall be a system, including coupling housing, gasket, fasteners, all furnished by the same manufacturer. Joint installation shall be in compliance with joint manufacturer's written instructions.

Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A536. Provide gaskets for use in grooved joints shall constructed of molded synthetic polymer of pressure responsive design and shall conform to ASTM D2000 for circulating medium up to 230 degrees F. Provide grooved joints in conformance with AWWA C606.

2.6.4 Solder

Provide solder in conformance with ASTM B32, grade Sb5, tin-antimony alloy. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B813.

2.6.5 Brazing Filler Metal

Filler metal shall conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.7 VALVES

Provide valves with a ANSI/ASME Class 125 service rating, which for 150 degrees F, the pressure rating is 175 psig.

Valves in sizes larger than 1 inch and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be furnished by the same manufacturer as the grooved pipe joint and fitting system.

2.7.1 Gate Valve

Gate valves 2-1/2 inches and smaller shall conform to MSS SP-80 Class 125 and shall be bronze with wedge disc, rising stem and threaded, soldered, or flanged ends. Gate valves 3 inches and larger shall conform to MSS SP-70, Class 125, cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.

2.7.2 Globe and Angle Valve

Globe and angle valves 2-1/2 inches and smaller shall conform to MSS SP-80, Class 125. Globe and angle valves 3 inches and larger shall conform to MSS SP-85, Class 125.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.7.3 Check Valve

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80. Check valves 3 inches and larger shall conform to MSS SP-71, Class 125.

2.7.4 Butterfly Valve

Butterfly valves shall conform to MSS SP-67, Type 1 and shall be either the wafer or lug type. Valves smaller than 8 inches shall have throttling handles with a minimum of two locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators.

2.7.5 Plug Valve

Plug valves 2 inches and larger shall conform to MSS SP-78, have flanged or threaded ends, and have cast iron bodies with bronze trim. Valves 2 inches and smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valve shall be lubricated, non-lubricated, or tetrafluoroethylene resin-coated type. Valve shall be resilient, double seated, trunnion mounted with tapered lift plug capable of 2-way shutoff. Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valves 8 inches or larger shall be provided with manual gear operators with position indicators.

2.7.6 Ball Valve

Full port design. Ball valves 1/2 inch and larger shall conform to MSS SP-72 or MSS SP-110 and shall be cast iron or bronze with threaded, soldered, or flanged ends. Valves 8 inches or larger shall be provided with manual gear operators with position indicators. Ball valves may be provided in lieu of gate valves.

2.7.7 Square Head Cocks

Provide copper alloy or cast-iron body with copper alloy plugs, suitable for 125 psig water working pressure.

2.7.8 Calibrated Balancing Valves

Copper alloy or cast iron body, copper alloy or stainless internal working parts. Provide valve calibrated so that flow can be determined when the temperature and pressure differential across valve is known. Valve shall have an integral pointer which registers the degree of valve opening. Valve shall function as a service valve when in fully closed position. Valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation.

Provide valve bodies with tapped openings and pipe extensions with positive shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable differential pressure meter connections to verify the pressure differential. Provide metal tag on each valve showing the gallons per minute flow for each differential pressure reading.

2.7.9 Automatic Flow Control Valves

Valve shall automatically maintain the constant flow indicated on the

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

design drawings. Valve shall modulate by sensing the pressure differential across the valve body. Valve shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Provide valve that controls the flow within 5 percent of the tag rating. Valve materials shall be the same as specified for the ball or plug valves.

Provide valve that are electric type as indicated. Valve shall be capable of positive shutoff against the system pump head, valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings and differential meter, suitable for the operating pressure specified. Provide the meter complete with hoses, vent, integral metering connections, and carrying case as recommended by the valve manufacturer.

2.7.10 Water Temperature Mixing Valve

Valve, ASSE 1017 for water service.

2.7.11 Water Temperature Regulating Valves

Provide copper alloy body, direct acting, pilot operated, for the intended service.

2.7.12 Water Pressure Reducing Valve

Valve, ASSE 1003 for water service, copper alloy body.

2.7.13 Pressure Relief Valve

Valve shall prevent excessive pressure in the piping system when the piping system reaches its maximum heat buildup. Valve, ANSI Z21.22/CSA 4.4 and shall have cast iron bodies with corrosion resistant internal working parts. The discharge pipe from the relief valve shall be the size of the valve outlet unless otherwise indicated.

2.7.14 Combination Pressure and Temperature Relief Valves

ANSI Z21.22/CSA 4.4, copper alloy body, automatic re-seating, test lever, and discharge capacity based on AGA temperature steam rating.

2.7.15 Float Valve

Angle pattern and or Globe pattern. Valve bodies 3 inches nominal pipe size and smaller shall be bronze. Valve bodies larger than 3 inches shall be cast iron or bronze. Steel parts shall be corrosion resistant. Where float rods are extended for tank applications, extension shall be properly supported and guided to avoid bending of float rod or stressing of valve pilot linkage.

2.7.16 Drain Valves

Valves, MSS SP-80 gate valves. Valve shall be manually-operated, 3/4 inch pipe size and above with a threaded end connection. Provide valve with a water hose nipple adapter. Freeze-proof type valves shall be provided in installations exposed to freezing temperatures.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.7.17 Air Venting Valves

Manually-operated general service type air venting valves, brass or bronze valves that are furnished with threaded plugs or caps. Air venting valves on water coils shall have not less than 1/8 inch threaded end connections. Air venting valves on water mains shall have not less than 3/4 inch threaded end connections. Air venting valves on all other applications shall have not less than 1/2 inch threaded end connections.

2.7.18 Vacuum Relief Valves

ANSI Z21.22/CSA 4.4

2.8 PIPING ACCESSORIES

2.8.1 Strainer

Strainer, ASTM F1199, except as modified and supplemented in this specification. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. Strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. Provide blowoff outlet with pipe nipple, gate valve, and discharge pipe nipple. The bodies shall have arrows clearly cast on the sides indicating the direction of flow.

Provide strainer with removable cover and sediment screen. The screen shall be made of minimum 22 gauge brass sheet, with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.8.2 Cyclonic Separator

Metal-bodied, with removal capability of removing solids 45 microns/325 mesh in size and heavier than 1.20 specific gravity, maximum pressure drop of 5 psid, with cleanout connection.

2.8.3 Combination Strainer and Pump Suction Diffuser

Angle type body with removable strainer basket and internal straightening vanes, a suction pipe support, and a blowdown outlet and plug. Strainer shall be in accordance with ASTM F1199, except as modified and supplemented by this specification. Unit body shall have arrows clearly cast on the sides indicating the direction of flow.

Strainer screen shall be made of minimum 22 gauge brass sheet, with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe. Flow shall be into the screen and out through the perforations. Provide an auxiliary disposable fine mesh strainer which shall be removed 30 days after start-up. Provide warning tag for operator indicating scheduled date for removal.

Casing shall have connection sizes to match pump suction and pipe sizes, and be provided with adjustable support foot or support foot boss to relieve piping strains at pump suction. Provide unit casing with blowdown port and plug. Provide a magnetic insert to remove debris from system.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.8.4 Flexible Pipe Connectors

Provide flexible bronze or stainless steel piping connectors with single braid. Equip flanged assemblies with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Provide covers to protect the bellows where indicated.

2.8.5 Pressure and Vacuum Gauges

Gauges, ASME B40.100 with throttling type needle valve or a pulsation dampener and shut-off valve. Provide gauges with 4.5 inch dial, brass or aluminum case, bronze tube, and siphon. Gauge shall have a range from 0 psig to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

2.8.6 Temperature Gauges

Temperature gauges, shall be the industrial duty type and be provided for the required temperature range. Provide gauges with fixed thread connection, dial face gasketed within the case; and an accuracy within 2 percent of scale range. Gauges shall have Fahrenheit scale in 2 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 5 feet of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 5 to 7 feet above the finished floor or in locations indicated. Remote element type temperature gauges shall be provided in thermal wells located 7 feet above the finished floor or in locations indicated.

2.8.6.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

2.8.6.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment.

2.8.6.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

2.8.6.4 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

2.8.7 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports: to MSS SP-58. If ferrous materials are utilized provide hot-dipped galvanized hangers, inserts and supports.

2.8.8 Escutcheons

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Secure plates in place by internal spring tension or set screws. 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.

2.8.9 Expansion Joints

2.8.9.1 Slip-Tube Type

Slip-tube expansion joints, ASTM F1007, Class I or II. Joints shall be provided with internally-externally alignment guides, injected semi-plastic packing, and service outlets. End connections shall be flanged or beveled for welding as indicated. Initial settings shall be made in accordance with the manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer.

2.8.9.2 Flexible Ball Type

Flexible ball expansion joints shall be capable of 360 degrees rotation plus 15 degrees angular flex movement. Joints shall be constructed of carbon steel with the exterior spherical surface of carbon steel balls plated with a minimum 5 mils of hard chrome in accordance with EJMA Stds. Joint end connections shall be threaded for piping 2 inches or smaller. Joint end connections larger than 2 inches shall be grooved, flanged, or beveled for welding. Provide joint with pressure-molded composition gaskets suitable for continuous operation at twice design temperature.

2.8.9.3 Bellows Type

Bellows expansion type joints, ASTM F1120 with Type 304 stainless steel corrugated bellows, reinforced with equalizing rings, internal sleeves, and external protective covers. Joint end connections shall be grooved, flanged, or beveled for welding. Guiding of piping on both sides of expansion joint shall be in accordance with the published recommendations of the manufacturer of the expansion joint.

2.9 PUMPS

Pumps shall be the electrically driven, non-overloading, centrifugal type which conform to HI 1.1-1.2. Pumps shall be selected at or within 5 percent of peak efficiency. Pump curve shall rise continuously from maximum capacity to shutoff. Pump motor shall conform to NEMA MG 1, be totally enclosed, and have sufficient horsepower for the service required. Pump motor shall have the required capacity to prevent overloading with pump operating at any point on its characteristic curve.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Pump speed shall not exceed 3,600 rpm, except where the pump head is less than 60 feet of water, the pump speed shall not exceed 1,750 rpm. Pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in the cover.

2.9.1 Construction

Each pump casing shall be designed to withstand the discharge head specified plus the static head on system plus 50 percent of the total, but not less than 125 psig. Pump casing and bearing housing shall be close grained cast iron. High points in the casing shall be provided with manual air vents; low points shall be provided with drain plugs. Provide threaded suction and discharge pressure gage tapping with square-head plugs.

Impeller shall be statically and dynamically balanced. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve shall be bronze. Shaft shall be carbon or alloy steel, turned and ground. Bearings shall be ball-bearings, roller-bearings, or oil-lubricated bronze-sleeve type bearings, and be efficiently sealed or isolated to prevent loss of oil or entrance of dirt or water.

Pump and motor shall be mounted on a common cast iron base having lipped edges and tapped drainage openings or structural steel base with lipped edges or drain pan and tapped drainage openings. Pump shall be provided with steel shaft coupling guard. Base-mounted pump, coupling guard, and motor shall each be bolted to a fabricated steel base which shall have bolt holes for securing base to supporting surface. Pump shall be accessible for servicing without disturbing piping connections. Shaft seals shall be mechanical-seals or stuffing-box type.

2.9.2 Mechanical Shaft Seals

Seals shall be single, inside mounted, end-face-elastomer bellows type with stainless steel spring, brass or stainless steel seal head, carbon rotating face, and tungsten carbide or ceramic sealing face. Glands shall be bronze and of the water-flush design to provide lubrication flush across the face of the seal. Bypass line from pump discharge to flush connection in gland shall be provided, with filter or cyclone particle separator in line.

2.9.3 Stuffing-Box Type Seals

Stuffing box shall include minimum four rows of square, impregnated TFE (Teflon) or graphite cord packing and a bronze split-lantern ring. Packing gland shall be bronze interlocking split type.

2.10 EXPANSION TANKS

Tank shall be welded steel, constructed for, and tested to pressure-temperature rating of 125 psi at 150 degrees F. Provide tanks precharged to the minimum operating pressure. Tank shall have a replaceable polypropylene or butyl lined diaphragm which keeps the air charge separated from the water; shall be the captive air type.

Tanks shall accommodate expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. Each tank air chamber shall be fitted with a drain, fill, an

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

air charging valve, and system connections. Tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The only air in the system shall be the permanent sealed-in air cushion contained within the expansion tank.

2.11 AIR SEPARATOR TANKS

Design to separate air from water and to direct released air to automatic air vent. Unit shall be of one piece cast-iron construction with internal baffles and two air chambers at top of unit; one air chamber shall have outlet to expansion tank and other air chamber shall be provided with automatic air release device. Tank shall be steel, constructed for, and tested to a ANSI Class 125 pressure-temperature rating.

2.12 WATER TREATMENT SYSTEMS

When water treatment is specified, the use of chemical-treatment products containing equivalent chromium (CPR) is prohibited.

2.12.1 NOT USED

2.12.2 Chilled Water

Water to be used in the chilled water systems shall be treated to maintain the conditions recommended by this specification as well as the recommendations from the manufacturers of the condenser and evaporator coils. Chemicals shall meet all required federal, state, and local environmental regulations for the treatment of evaporator coils and direct discharge to the sanitary sewer.

2.12.3 Glycol Solution

A 30 percent concentration by volume of industrial grade ethylene glycol shall be provided in the chilled water. The glycol shall be tested in accordance with ASTM D1384 with less than 0.5 mils penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicate based inhibitors shall not be used. The solution shall be compatible with pump seals, other elements of the system, and water treatment chemicals used within the system.

2.12.4 NOT USED

2.12.5 Chilled Water System

A shot feeder shall be provided on the chilled water piping as indicated. Size and capacity of feeder shall be based on local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

2.12.6 NOT USED

2.13 ELECTRICAL WORK

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,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. 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, shall be provided. For packaged equipment, the manufacturer shall provide controllers including the required monitors and timed restart.

Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11.

Provide polyphase, squirrel-cage medium induction motors, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. 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.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall 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. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Provide variable frequency drives for motors as specified in Section 26 29 23 ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS.

2.14 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

2.14.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided. The factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test.

Salt-spray fog test shall be in accordance with ASTM B117, and for that test, the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen.

If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

2.14.2 Shop Painting Systems for Metal Surfaces

Clean, retreat, 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where hot-dip galvanized steel has been cut, resulting surfaces with no galvanizing shall be coated with a zinc-rich coating conforming to ASTM D520, Type I.

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. Color of finish coat shall be aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive 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.
- b. Temperatures Between 120 and 400 degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.
- c. Temperatures Greater Than 400 degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

2.15 FACTORY APPLIED INSULATION

Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 25 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 shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E84.

Insulation shall 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 shall be tested as a composite material. Jackets, facings, and adhesives shall 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.

2.16 NAMEPLATES

Major equipment including pumps, pump motors, expansion tanks, and air separator tanks shall have the manufacturer's name, type or style, model or serial number on a plate secured to the item of equipment. The nameplate of the distributing agent will not be acceptable. Plates shall be durable and legible throughout equipment life and made of anodized aluminum. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.17 RELATED COMPONENTS/SERVICES

2.17.1 Drain and Make-Up Water Piping

Requirements for drain and make-up water piping and backflow preventer is specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.17.2 Field Applied Insulation

Requirements for field applied insulation is specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.17.3 Field Applied Insulation

Requirements for field installed insulation is specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as supplemented and modified by this specification section.

2.17.4 Field Painting

Requirements for painting of surfaces not otherwise specified, and finish painting of items only primed at the factory, are specified in Section 09 90 00 PAINTS AND COATINGS.

2.17.4.1 Color Coding

Requirements for color coding for piping identification are specified in Section 09 90 00 PAINTS AND COATINGS.

PART 3 EXECUTION

3.1 INSTALLATION

Cut pipe accurately to measurements established at the jobsite, and work into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation is not permitted without written approval. Cut pipe or tubing square, remove burrs by reaming, and fashion to permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.1.1 Welding

Provide welding work specified this section for piping systems in conformance with ASME B31.9, as modified and supplemented by this specification section and the accompanying drawings. The welding work includes: qualification of welding procedures, welders, welding operators, brazers, brazing operators, and nondestructive examination personnel; maintenance of welding records, and examination methods for welds.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.1.1 Employer's Record Documents (For Welding)

Submit for review and approval the following documentation. This documentation and the subject qualifications shall be in compliance with ASME B31.9.

- a. List of qualified welding procedures that is proposed to be used to provide the work specified in this specification section.
- b. List of qualified welders, brazers, welding operators, and brazing operators that are proposed to be used to provide the work specified in this specification section.
- c. List of qualified weld examination personnel that are proposed to be used to provide the work specified in this specification section.

3.1.1.2 Welding Procedures and Qualifications

- a. Specifications and Test Results: Submit copies of the welding procedures specifications and procedure qualification test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds. Submit this information on the forms printed in ASME BPVC SEC IX or their equivalent.
- b. Certification: Before assigning welders or welding operators to the work, submit a list of qualified welders, together with data and certification that each individual is performance qualified as specified. Do not start welding work prior to submitting welder, and welding operator qualifications. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

3.1.1.3 Examination of Piping Welds

Conduct non-destructive examinations (NDE) on piping welds and brazing and verify the work meets the acceptance criteria specified in ASME B31.9. NDE on piping welds covered by ASME B31.9 is visual inspection only. Submit a piping welds NDE report meeting the requirements specified in ASME B31.9.

3.1.1.4 Welding Safety

Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

3.1.2 Directional Changes

Make changes in direction with fittings, except that bending of pipe 4 inches and smaller is permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees is not permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations is not acceptable.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.3 Functional Requirements

Pitch horizontal supply mains down in the direction of flow as indicated. The grade shall not be less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Cap or plug open ends of pipelines and equipment during installation to keep dirt or other foreign materials out of the system.

Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 2-1/2 inches or less in diameter, and with flanges for pipe 3 inches and above in diameter. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric waterways or flanges.

Piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance. Electric isolation fittings shall be provided between dissimilar metals.

3.1.4 Fittings and End Connections

3.1.4.1 Threaded Connections

Threaded connections shall be made with tapered threads and made tight with PTFE tape complying with ASTM D3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

3.1.4.2 Brazed Connections

Brazing, AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Piping shall be supported prior to brazing and not be sprung or forced.

3.1.4.3 Welded Connections

Branch connections shall be made with welding tees or forged welding branch outlets. Pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding, the pipe and fittings shall be filled with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.9. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1/D1.1M or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.4.4 Grooved Mechanical Connections

Prepare grooves in accordance with the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or 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 shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.1.4.5 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.1.4.6 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for the intended application.

3.1.5 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.6 Air Vents

Air vents shall be provided at all high points, on all water coils, and where indicated to ensure adequate venting of the piping system.

3.1.7 Drains

Drains shall be provided at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.8 Flexible Pipe Connectors

Connectors shall be attached to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.

3.1.9 Temperature Gauges

Temperature gauges shall be located on coolant supply and return piping at each heat exchanger, on condenser water piping entering and leaving a condenser, at each automatic temperature control device without an integral thermometer, and where indicated or required for proper operation of equipment. Thermal wells for insertion thermometers and thermostats

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

shall extend beyond thermal insulation surface not less than 1 inch.

3.1.10 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58, except as supplemented and modified in this specification section. Pipe hanger types 5, 12, and 26 shall not be used. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. 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.

3.1.10.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.1.10.2 Inserts

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

3.1.10.3 C-Clamps

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

3.1.10.4 Angle Attachments

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

3.1.10.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

3.1.10.6 Horizontal Pipe Supports

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.

3.1.10.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.10.8 Pipe Guides

Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.1.10.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle shall be used. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

3.1.10.10 Multiple Pipe Runs

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.

3.1.10.11 Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified under Sections 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS and 23 05 48.19 SEISMIC BRACING FOR HVAC. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.1.10.12 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 floors or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support shall be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.1.11 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

3.1.12 Pipe Anchors

Anchors shall be provided where indicated. Unless indicated otherwise, anchors shall comply with the requirements specified. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required.

Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, these items shall be anchored immediately adjacent to each penetrated surface, to provide essentially zero movement within penetration seal.

3.1.13 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Except as indicated otherwise piping sleeves shall comply with requirements specified. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A653/A653M, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A53/A53M, Schedule 30. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

3.1.13.1 Refrigerated Space

Refrigerated space building surface penetrations shall be fitted with sleeves fabricated from hand-lay-up or helically wound, fibrous glass reinforced polyester or epoxy resin with a minimum thickness equal to equivalent size Schedule 40 steel pipe. Sleeves shall be constructed with integral collar or cold side shall be fitted with a bonded slip-on flange or extended collar.

In the case of masonry penetrations where sleeve is not cast-in, voids shall be filled with latex mixed mortar cast to shape of sleeve and flange/external collar type sleeve shall be assembled with butyl elastomer vapor barrier sealant through penetration to cold side surface vapor barrier overlap and fastened to surface with masonry anchors.

Integral cast-in collar type sleeve shall be flashed with not less than 4 inches of cold side vapor barrier overlap of sleeve surface. Normally noninsulated penetrating round surfaces shall be sealed to sleeve bore with mechanically expandable seals in vapor tight manner and remaining warm and cold side sleeve depth shall be insulated with not less than 4 inches of foamed-in-place rigid polyurethane or foamed-in-place silicone elastomer.

Vapor barrier sealant shall be applied to finish warm side insulation surface. Warm side of penetrating surface shall be insulated beyond vapor barrier sealed sleeve insulation for a distance which prevents condensation. Wires in refrigerated space surface penetrating conduit shall be sealed with vapor barrier plugs or compound to prevent moisture migration through conduit and condensation therein.

3.1.13.2 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07 92 00 JOINT SEALANTS.

3.1.13.3 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a .17 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange.

Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods.

- a. Waterproofing Clamping Flange: Pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.
- b. Modular Mechanical Type Sealing Assembly: In lieu of a waterproofing clamping flange, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut.
- c. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

3.1.13.4 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07 84 00 FIRESTOPPING.

3.1.13.5 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.14 Access Panels

Access panels shall be provided where indicated for all concealed valves, vents, controls, and additionally for items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 08 31 00 ACCESS DOORS AND PANELS.

3.2 INSTALLATION FOR POLYPROPYLENE PIPING (CHILLED WATER APPLICATIONS ONLY)

3.2.1 Locations

Plastic pipe to include polypropylene shall not be installed in air plenums. Plastic pipe to include polypropylene shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

3.2.2 Pipe Joints

Joints for polypropylene pipe and fittings shall be made by heat fusion welding socket-type or butt-fusion type fittings and shall comply with ASTM F2389. Joint surfaces shall be clean and free from moisture, and shall be undisturbed until cool.

3.2.3 Overheating Precautions

Adequate provisions shall be taken to ensure that the pipe does not exceed operating temperatures recommended by the manufacturer. This includes a safeguard provision from preventing a pump from running with zero flow, if such operation could overheat the pipe beyond pipe manufacturer's recommendations. If heat tracing is permitted elsewhere in the specifications, ensure that the heat tracing is installed per piping manufacturer's recommendations to prevent overheating of the pipe.

3.2.4 Testing and Flushing

Pressure test shall be conducted for 15 minutes at 1.5 times the operating pressure or 150 psi, whichever is greater, with no observable loss in pressure. Water, rather than air, must be used for pressure testing plastic pipe. After satisfactory pressure test is obtained, flush piping system using a minimum velocity of 4 fps through all portions of the piping system. Flushing shall be continued until discharge water shows no discoloration and strainers are no longer collecting dirt and other foreign materials. Upon completion of flushing, drain all water from system at low points, and remove/clean/replace strainers.

3.3 ELECTRICAL INSTALLATION

Install electrical equipment in accordance with NFPA 70 and manufacturers instructions.

3.4 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for all water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

removed from all water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed.

3.5 FIELD TESTS

Field tests shall be conducted in the presence of the QC Manager or his designated representative to verify systems compliance with specifications. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor.

3.5.1 Equipment and Component Isolation

Prior to testing, equipment and components that cannot withstand the tests shall be properly isolated.

3.5.2 Pressure Tests

Each piping system, except for polypropylene piping, shall be hydrostatically tested at a pressure not less than 188 psig for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Test pressure shall be monitored by a currently calibrated test pressure gauge. Leaks shall be repaired and piping retested until test requirements are met. No leakage or reduction in gage pressure shall be allowed.

Leaks shall be repaired by rewelding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before concealing.

Submit for approval pressure tests reports covering the above specified piping pressure tests; describe the systems tested, test results, defects found and repaired, and signature of the pressure tests' director. Obtain approval from the QC Manager before concealing piping or applying insulation to tested and accepted piping.

3.5.3 NOT USED

3.5.4 Related Field Inspections and Testing

3.5.4.1 Piping Welds

Examination of Piping Welds is specified in the paragraph EXAMINATION OF PIPING WELDS (above).

3.5.4.2 HVAC TAB

Requirements for testing, adjusting, and balancing (TAB) of HVAC water piping, and associated equipment is specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Coordinate with the TAB team, and provide support personnel and equipment as specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC to assist TAB team to meet the TAB work requirements.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.6 INSTRUCTION TO GOVERNMENT PERSONNEL

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 chilled-hot water, . Instructors shall be thoroughly familiar with all parts of the installation and shall be instructed in operating theory as well as practical operation and maintenance work. Submit a lesson plan for the instruction course for approval. The lesson plan and instruction course shall be based on the approved operation and maintenance data and maintenance manuals.

Conduct a training course for the operating staff and maintenance staff selected by the Contracting Officer. Give the instruction 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 one man-day. Use approximately half of the time for classroom instruction and the other time for instruction at the location of 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.

3.7 NOT USED

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 25 05 11.01

CYBERSECURITY FOR LOW IMPACT HEATING, VENTILATION AND AIR CONDITIONING (HVAC) FACILITY-RELATED CONTROL SYSTEMS

08/24

PART 1 GENERAL

Many subparts in this Section contain text in curly braces ("{" and "}") indicating which cybersecurity control and control correlation identifier (CCI) the requirements of the subpart relate to. The text inside these curly braces is for Government reference only and enables coordination of the requirements of this Section with the RMF process throughout the design and construction process. Text in curly braces are not contractor requirements.

This Section refers to Security Requirements Guide (SRGs) and Security Technical Implementation Guide (STIGs). STIGs and SRGs are available online at the Information Assurance Support Environment (IASE) website at <https://public.cyber.mil/stigs/downloads/> and an SRG/STIG Applicability Guide and Collection Tool is available at <https://public.cyber.mil/stigs/SCAP/>. Not all control system components have applicable STIGs or SRGs. The "Control Systems SRG" does not apply to work performed under this Section; all requirements within this section to apply applicable SRGs DO NOT include the "Control Systems SRG".

1.1 CONTROL SYSTEM APPLICABILITY

There are multiple versions of this Section associated with this project. Different versions have requirements applicable to different control systems. This specific Section applies only to the following control system: Heating, Ventilation & Air Conditioning (HVAC) DDC and Utility Monitoring Control System (UMCS/Meters). This system has a CIA Impact Level of LLL.

1.2 RELATED REQUIREMENTS

This section does not contain sufficient requirements to procure a control system and must be used in conjunction with other Sections which specify control systems. This Section adds cybersecurity requirements to the control systems specified in other Sections, and as these requirements are conditioned on the control system being provided, there may be requirements in this Section that will not apply to this project. All Sections containing facility-related control systems or control system components are related to the requirements of this Section. Review all specification sections to determine related requirements.

In cases where a requirement is specified in both this Section and in another Section, the more stringent requirement must be met. In cases where a requirement in this Section conflicts with the requirements of another Section such that both requirements cannot be met at the same time, request direction from the Contracting Officer to determine which requirement applies to the project.

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.1x	(2010) Local and Metropolitan Area Networks - Port Based Network Access Control
-------------	---

INTERNET ENGINEERING TASK FORCE (IETF)

IETF RFC 2819	(2000) Remote Network Monitoring (RMON) Management Information Base (MIB)
---------------	--

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST FIPS 140-2	(2001) Security Requirements for Cryptographic Modules
NIST FIPS 201-2	(2013) Personal Identity Verification (PIV) of Federal Employees and Contractors

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 8551.01	(2014) Ports, Protocols, and Services Management (PPSM)
DTM 08-060	(2008) Policy on Use of Department of Defense (DoD) Information Systems - Standard Consent Banner and User Agreement

1.4 DEFINITIONS

1.4.1 Administrator Account

An administrator account is an account with full permissions to a device, application, or operating system, including the ability to create and modify other user accounts.

Note that the operating system Administrator Account may be different than Administrator Accounts for applications hosted on that operating system. Also, most controllers will not have any support for accounts and will therefore not have an 'Administrator Account'.

1.4.2 Computer

A computer is one of the following:

- a. a device running a non-embedded desktop or server version of Microsoft Windows
- b. a device running a non-embedded version of MacOS
- c. a device running a non-embedded version of Linux
- d. a device running a version or derivative of the Android Operating System, where Android is considered separate from Linux
- e. a device running a version of Apple iOS

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Unless otherwise indicated or clear from context use of the word "device" in this Section includes computers.

1.4.3 Controller

A device other than a computer or Ethernet switch.

1.4.4 Mission Space

A device or media is in mission space if physical access to the device or media is controlled by the organization served by the device. For example, a variable air volume (VAV) box controller in a suspended ceiling is in mission space if the VAV box serves that room; an electrical switchgear in an electrical room or an air handling unit (AHU) in a mechanical room or on a rooftop may still be considered to be in mission space if the organization (mission) served by that switchgear or AHU controls access to the electrical room, mechanical room or rooftop.

1.4.5 Network

A network is a group of two or more devices that can communicate using a network protocol. Network protocols must provide a method for addressing devices on the network; a communication method that does not provide an addressing scheme is not a networked form of communication. Devices that communicate using a method of communication that does not support device addressing are not using a network. Addresses may be other than IP addresses, and addressing may be at either Open Systems Interconnection (OSI) layer 2 or layer 3.

1.4.6 Network Connected

A component is network connected (or "connected to a network") only when the device has a network transceiver which is directly connected to the network and implements the network protocol. A device lacking a network transceiver (and accompanying protocol implementation) can never be considered network connected. Note that (unlike many IT definitions of "Network Connected") a device connected to a non-IP network is still considered network connected (an IP connection or IP address is not required for a device to be network connected).

1.4.6.1 Wireless Network Connected

Any device that supports wireless network communication is network connected to a wireless network, regardless of whether the device is communicating using wireless. Unless physically disabled, devices with wireless transceivers support wireless, it is not sufficient to disable the wireless in software.

1.4.7 Network Media

The thing that provides the communication channel between the devices on a network. Typically wire, but might include wireless, fiber optic, or even power line (some network protocols allow sending network signals over power wiring).

1.4.8 User Account Support Levels

The support for user accounts is categorized in this Section as one of three levels:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4.8.1 FULLY Supported

Device supports configurable individual accounts. Accounts can be created, deleted, modified, etc. Privileges can be assigned to accounts. These devices support user-based (as opposed to role-based) authentication.

1.4.8.2 MINIMALLY Supported

Device supports a small, fixed number of accounts (perhaps only one). Accounts cannot be modified. A device with only a "User" and an "Administrator" account would fit this category. Similarly, a device with two PINs for logon - one for restricted and one for unrestricted rights would fit here (in other words, the accounts do not have to be the traditional "username and password" structure). These devices typically only support role-based authentication.

Examples of devices which MINIMALLY support accounts are a) a variable frequency drive with a single account which requires a PIN for access to configuration; and b) a room lighting control touchpad interface that has a single account.

1.4.8.3 NOT Supported

Device does not support any Access Enforcement therefore the whole concept of "account" is meaningless.

1.4.9 Manual Local Input

Manual Local Inputs are system analog or binary inputs that are adjustable by a person but are, by intrinsic hardware design, very limited in potential capabilities. Manual Local Inputs do not have touch screens or full keyboards, but may have a few buttons or dials to allow input. Manual Local Inputs do not have full graphic screens or dot-matrix displays, but may have simple lights (LEDs) or 7-segment displays. Manual Local Inputs do not have any sort of menu structure, each button has a single well-defined function.

Examples of Manual Local Inputs are H-O-A switches, simple thermostats, and disconnect switches.

1.4.10 Card Reader

A card reader is an input/output device whose primary function is to assist in two-factor authentication. A card reader must have an interface to read data from a card and may be able to write data to a card. A card reader may have a means (such as buttons, keypad, touchscreen, etc.) for a user to input a PIN or password, as well as a limited display.

1.4.11 User Interface

A User Interface (UI) is something other than a Manual Local Input or Card Reader that allows a person to interact with the system or device. Note that while a Card Reader is not by itself a User Interface, a User Interface may contain a Card Reader in order for it to authenticate its user. Within control systems, there are a wide range of User Interfaces.

Two important distinctions are 1) whether the user interface is Local or Remote, and 2) the effective capabilities of the User Interface to alter

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

data, which is the "privilege" of the user interface (where effective privilege available to a specific user at a specific user interface is the combination of the greatest privilege offered by the user interface and the specific account the user is logged into).

1.4.11.1 Local User Interface

A Local User Interface is a user interface where the physical hardware the user interacts with (keyboard, buttons, display, etc.) is physically part of the device being affected. All of the relevant characteristics of the user interface are embodied within a single device.

Note that a Local UI may be able to access data in a different device, Local versus Remote in this context refers to the user interface itself; the capability to access data in a different device is covered under "Full User Interface".

1.4.11.2 Remote User Interface

A Remote User Interface implements a Client/Server model where the physical hardware the user interacts with (Client) is physically distinct from the device being affected (Server). Most or all of the security and functionality characteristics of the user interface are defined by the Server, not the Client. The Client and Server communicate via a network connection. A common example of a remote user interface is a web-based interface where the browser (client) is generally on different hardware than the web server (server). A Remote UI remains a Remote UI even if the user happens to be at a Client on the same hardware as the Server. What is important is that a) the Client may be on different hardware than the Server and b) the majority of the security and functional characteristics of the interface are defined at the Server.

Note that this definition of "remote" is consistent with that generally used in the control industry but is not aligned with the NIST 800-53 definition of "Remote", which refers to "outside the system". The term "Remote" here better aligns with the NIST 800-53 definition of "Network" (remote from within the system) Access.

1.4.11.3 Types of User Interface (by capability)

User interfaces are also categorized by their capabilities as being Read Only, Limited, or Full.

1.4.11.3.1 Read-Only User Interface

A Read Only User Interface (also referred to as a View-Only User Interface) is a user interface that only allows for reading data, it does not allow (have the capability to) modify data. A Read Only User Interface may be either Local or Remote. A User Interface that is configured to be Read Only (by some other means than the interface itself, such as using configuration software on a laptop) is a Read-Only Interface. Note a Read Only User Interface may have buttons (or touch screen, etc.) allowing the user to navigate through the presentation of data.

Examples of a Read Only User Interfaces are a) a publicly viewable "energy dashboard" showing weather data and energy usage within a building and b) digital wayfinding signage.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4.11.3.2 Limited User Interface

A Limited User Interface is a user interface that - by design - can only alter information local to the user interface. Note that the determination of "alter" includes only direct interactions, it explicitly excludes interactions that might occur as secondary effects. For example, an interface changing the flow setpoint in a pump controller is a direct interaction, the subsequent change in flow (as well as any subsequent downstream changes in valve position) are not direct interactions.

Two examples of LIMITED UIs are: a) a variable speed drive has a Limited Local User Interface which allows the user to change properties within the drive, but does not allow affecting things outside the drive; and b) a typical home WiFi Router has a Limited Remote User Interface which allows configuration of the Router, but does not allow direct interaction with other devices.

1.4.11.3.3 Full User Interface

A Full User Interface can alter information in devices outside the device with the user interface. For example, a typical Local Display Panel is a Full Local User Interface while a browser-based front end is a Full Remote User Interface.

1.4.11.3.4 View-Only User Interface

See Read-Only User Interface

1.4.11.4 Other User Interface Terminology

In addition to defining whether a user interface is a Hardware Limited, Read-Only, Limited or Full, and whether it is Local or Remote, user interfaces are classified by whether they are writable or privileged.

1.4.11.4.1 Writable User Interface

Any User Interface that is not Read-Only is Writable. (Limited User Interfaces and Full User Interfaces are both writable user interfaces (as they are capable of changing a value)).

1.4.11.4.2 Privileged User Interface

A Privileged UI is a UI that has sufficient capabilities or functionality that it requires specific cybersecurity measures to be put in place to limit its unauthorized use. Ultimately, whether a specific user interface is considered a Privileged User Interface must be determined by usage. Unless otherwise specified, user interfaces can be determined to be privileged or not using the following:

- a. Read-Only User Interfaces are not privileged user interfaces.
- b. Full User Interfaces are privileged user interfaces.
- c. User interfaces that allow for configuration of auditing or allows for modification or deletion of audit logs are privileged user interface.
- d. User interfaces that allow for reprogramming a network connected device is a privileged user interface.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- e. Except as specified above, a Limited User Interface must be determined to be privileged or not based on the specific capabilities and use case of the user interface. In general however, user interfaces that do not offer significant capabilities above and beyond those available at that location via other means (e.g. such as a disconnect switch, breaker, or hand-off-auto switch, or physical attack) are not privileged.

1.4.12 Wireless Network

Any network that communicates without using wires or fiber optics as the communication media. Wireless networks include: WiFi, Bluetooth, ZigBee, cellular, satellite, long and short wave radio, 2.4 GHz, free space optical, point-to-point laser, microwave, and IR.

1.4.13 Wired Broadcast Network

Wired Broadcast Networks are any network, such as powerline carrier networks and modem (wired telephony), that use wire-based technologies where there is not a clearly defined boundary for signal propagation.

1.5 ADMINISTRATIVE REQUIREMENTS

1.5.1 Points of Contact

Coordinate with the following Points of Contact as indicated in this Section and as required. Not all projects will require coordination with all Points of Contact. When coordination is required and no Point of Contact is indicated, coordinate with the Contracting Officer (K0).

- a. Government Computer Access Point of Contact: Contracting Office (K0)
- b. HTTPS Certificate Point of Contact: Contracting Officer (K0)
- c. Email Address Point of Contact: Contracting Officer (K0)
- d. Password Point of Contact: Contracting Officer (K0)
- e. Mobile Code Point of Contact: Contracting Officer (K0).

1.5.2 Coordination

Coordinate the execution of this Section with the execution of all other Sections related to control systems as indicated in the paragraph RELATED REQUIREMENTS. Items that must be considered when coordinating project efforts include but are not limited to:

- a. If requesting permission for wireless or wired broadcast communication, the Wireless and Wired Broadcast Communication Request submittal must be approved prior to control system device selection and installation.
- b. If requesting permission for alternate account lock permissions, the Device Account Lock Exception Request must be approved prior to control system device selection and installation.
- c. If requesting permission for the use of a device with multiple physical connections to IP networks, the Multiple IP Connection Device Request must be approved prior to control system device selection and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

installation.

- d. Wireless testing may be required as part of the control system testing. See requirements for the Wireless Communication Test Report submittal.
- e. If the Device Audit Record Upload Software is to be installed on a computer not being provided as part of the control system, coordination is required to identify the computer on which to install the software.
- f. The Cybersecurity Interconnection Schedule must be coordinated with other work that will be interconnected to, and interconnections must be approved by the Government before relying on them for system functionality.
- g. Cybersecurity testing support must be coordinated across control systems and with the Government cybersecurity testing schedule.
- h. Passwords must be coordinated with the indicated contact for the project site.
- i. If applicable, HTTPS web server certificates must be obtained from the indicated HTTPS Certificate Point of Contact.
- j. Contractor Computer Cybersecurity Compliance Statements must be provided for each contractor using contractor owned computers.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Wireless and Wired Broadcast Communication Request; G
 Device Account Lock Exception Request; G
 Multiple Ethernet Connection Device Request; G
 Contractor Computer Cybersecurity Compliance Statements; G
 Contractor Temporary Network Cybersecurity Compliance Statements; G
 Cybersecurity Interconnection Schedule ; G
 Protection of Information At Rest Proposal; G
 Proposed STIG and SRG Applicability Report; G
 Pre-Construction Control System Inventory Report ; G

SD-02 Shop Drawings

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Network Communication, Ports, Protocols and Services Report; G
Cybersecurity Network (Riser) Diagram ; G

SD-03 Product Data

Control System Cybersecurity Documentation; G

SD-06 Test Reports

Control System Cybersecurity Testing Procedures; G
Control System Cybersecurity Testing Report; G

SD-07 Certificates

Software Licenses; G

SD-11 Closeout Submittals

Confidential Password Report; G
Enclosure Keys; G
Software and Configuration Backups; G
Auditing Front End Software; G
Device Audit Record Upload Software; G
System Maintenance Tool Software; G
Control System Scanning Tools; G
STIG, SRG and Vendor Guide Compliance Result Report; G
Final Control System Inventory Report; G
Integrity Verification Software; G

1.7 QUALITY CONTROL

1.7.1 Cybersecurity Subject Matter Expert Requirements

Cybersecurity Subject Matter Expert position, resumes should be submitted to the government within 14 days after Notice to Proceed. All certifications must be in effect prior to being hired. This position may serve across the contract.

1.7.2 Cybersecurity Subject Matter Expert Qualifications

The individual will oversee all work within this section. This position requires that the individual currently meets Information Assurance Technical Level II Certification in accordance with DoDI 8570 Information

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Workforce Improvement Program. Individuals for this position must have a minimum of two years experience securing DoD Systems and with Risk Management Framework. They must also have experience with Facility-Related Control Systems cybersecurity implementation such as control system-related training or certification. The individual is required to have a background check and be able to obtain a Common Access Card (CAC).

1.7.3 Cybersecurity Kickoff Meeting

Within 60 calendar days after contract award, the Cybersecurity Subject Matter Expert must schedule a Cybersecurity Kickoff Meeting with the Contracting Officer, System Owner, System Program Manager, and Information System Security Manager (ISSM).

1.8 CYBERSECURITY DOCUMENTATION

{For Government Reference Only: This subpart (and its subparts) relates to PL-7; CCI-003071}

1.8.1 Proposed STIG and SRG Applicability Report

For each model of network connected or network infrastructure device, use the DISA SRG/STIG Applicability Guide and Collection Tool (available at <https://public.cyber.mil/stigs/SCAP/>) to identify applicable STIGs or SRGs and provide a report indicating applicable STIGs and SRGs for each model. Provide the Proposed STIG and SRG Applicability Report concurrently with the Pre-Construction Control System Inventory Report.

1.8.2 Cybersecurity Interconnection Schedule

{For Government Reference Only: This subpart relates to CA-3(b), PL-8, SC-7(9), SC-7(11); CCI-000258, CCI-003072, CCI-003073, CCI-003075, CCI-002398, CCI-002399, CCI-002401, CCI-002402, CCI-002403. For MODERATE Impact systems, this subpart also relates to SC-7; CCI-001126, CCI-001109}

Provide a completed Cybersecurity Interconnection Schedule documenting network connections between the installed system and other systems. Provide the following information for each device directly communicating between systems: Device Identifier, Device Manufacturer, Device Description, Transport layer Protocol, Network Address, Port (if applicable), MAC (Layer 2) address (if applicable), Media, Application Protocol, Service (if applicable), Descriptive Purpose of communication. For communication with other authorized systems also provide the Foreign Destination and POC for Destination. For MODERATE Impact Systems: Also describe the impact of loss of the connection on the control system. If other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Cybersecurity Interconnection Schedule as an editable Microsoft Excel file (a template Cybersecurity Interconnection Schedule in Excel format is available at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1>)

1.8.3 Network Communication, Ports, Protocols and Services Report

{For Government Reference Only: This subpart (and its subparts) relates to CA-9, PL-8; CCI-002102, CCI-002103, CCI-002104, CCI-002105, CCI-003072,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

CCI-003073, CCI-003075 and also the submittal requirements associated with CM-6, CM-7, including CM-7(3), CCI-000388.}

Provide a Network Communication, Ports, Protocols and Services Report. For each networked device, document device identifier and the communication characteristics of the device including communication protocols, services used, encryption employed, and a general description of what information is communicated over the network. For each device using IP communication, document all TCP and UDP ports used. For each device using non-IP communication, document communication protocol and media used. If other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Network Communication, Ports, Protocols and Services Report as an editable Microsoft Excel file.

1.8.4 Control System Inventory Reports

{For Government Reference Only: This subpart (and its subparts) relates to CM-8(a), SI-17, IA-3; CCI-000389, CCI-000392, CCI-000398, CCI-002773, CCI-002774, CCI-002775, CCI-000777, CCI-000778, CCI-001958}

Provide a Pre-Construction Control System Inventory Report report and a Final Control System Inventory Report, using the Inventory Spreadsheet listed under this Section at

<https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1>

In the Control System Inventory Reports, document all networked devices, including network infrastructure devices. For each device provide all applicable information for which there is a field on the spreadsheet in accordance with the instructions on the spreadsheet.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Control System Inventory Reports as editable Microsoft Excel files. Provide the Pre-Construction Control System Inventory Report concurrently with the Proposed STIG and SRG Applicability Report

1.8.5 Software and Configuration Backups

{For Government Reference Only: This subpart (and its subparts) relates to CP-10; CCI-000550, CCI-000551, CCI-000552}

For each computer on which software is installed under this project, provide a recovery image of the final as-built computer. This image must allow for bare-metal restore such that restoration of the image is sufficient to restore system operation to the imaged state without the need for re-installation of software. If additional user permissions are required to meet this requirement, coordinate the creation of the image with the identified Government Computer Access Point of Contact.

For all Ethernet switches provide a backup of the switch configuration. For all controllers, provide a backup of the controller configuration and the source code for all loaded application programs (all software that is not common to every controller of the same manufacturer and model).

If any or all of these are provided under another Section, provide documentation indicating this and referencing those submittals.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.8.6 Cybersecurity Network (Riser) Diagram

{For Government Reference Only: This subpart (and its subparts) relates to PL-2(a), PL-8; CCI-003051, CCI-003053, CCI-003072, CCI-003073, CCI-003075}

Provide a cybersecurity network (riser) diagram of the complete control system including all network and device hardware. For each device, include the device identifier, device type, and manufacturer. If the control system specifications require a riser diagram submittal, provide a copy of that submittal as the cybersecurity riser diagram. Otherwise, provide a riser diagram in one-line format.

1.8.7 STIG, SRG and Vendor Guide Compliance Result Report

For every component (device or software) with an applicable STIG or SRG in the Proposed STIG and SRG Applicability Report, document compliance with the STIG or SRG requirements.

- a. For components which are scannable by the SCAP (security content automation protocol) tool (available online at <https://public.cyber.mil/stigs/scap>), include the SCAP report or the Evaluate-STIG tool (available online at (CAC Required)), include the Evaluate-STIG report and raw scan results in addition to the final, manually reviewed and revised, documentation of compliance with STIG and SRG requirements. Checklist files should not contain any findings with a Not Reviewed (NR) status after manual reviews.
- b. For components which do not support automated scanning, a manual review using the General Purpose STIG option should be done. A completed Checklist file should not contain any findings with a Not Reviewed (NR) status after manual reviews

For every component (device or software) with manufacturer provided cybersecurity documentation, procedure, or method for secure configuration or installation, provide a report documenting how the component was configured and any deviation from the manufacturer instructions.

1.8.8 Control System Cybersecurity Documentation

{For Government Reference Only: This subpart (and its subparts) relates to SA-5(a), SA-5(b), SA-5(c), SA-22(b); CCIs: CCI-003124, CCI-003125, CCI-003126, CCI-003127, CCI-003128, CCI-003129, CCI-003130, CCI-003131, CCI-003374}

Provide a Control System Cybersecurity Documentation submittal containing the indicated information for each device and software application.

1.8.8.1 Software Applications

For all software applications running on computers provide:

- a. administrator documentation that describes secure configuration of the software {For Government Reference Only: relates to CCI-003124}
- b. administrator documentation that describes secure installation of the software and software updates. {For Government Reference Only:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

relates to CCI-003125}

- c. administrator documentation that describes secure operation of the software {For Government Reference Only: relates to CCI-003124}
- d. administrator documentation that describes effective use and maintenance of security functions or mechanisms for the software {For Government Reference Only: relates to CCI-003127}
- e. administrator documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the software {For Government Reference Only: relates to CCI-003128}
- f. user documentation that describes user-accessible security functions or mechanisms in the software and how to effectively use those security functions or mechanisms {For Government Reference Only: relates to CCI-003129}
- g. user documentation that describes methods for user interaction which enables individuals to use the software in a more secure manner {For Government Reference Only: relates to CCI-003130}
- h. user documentation that describes user responsibilities in maintaining the security of the software {For Government Reference Only: relates to CCI-003131}

1.8.8.2 For HVAC Control System Devices

1.8.8.2.1 HVAC Control System Devices FULLY Supporting User Accounts

For all HVAC Control System Devices which FULLY support user accounts, provide:

- a. Documentation that describes secure configuration of the device {For Government Reference Only: relates to CCI-003124}
- b. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}
- c. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government Reference Only: relates to CCI-003127}
- d. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {For Government Reference Only: relates to CCI-003128}
- e. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms; or a specific indication that there are no user-accessible security functions or mechanisms in the device {For Government Reference Only: relates to CCI-003129}
- f. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {For Government Reference Only: relates to CCI-003130}

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.8.8.2.2 All Other HVAC Control System Devices

For all HVAC Control System Devices which do not FULLY support user accounts, provide:

- a. Documentation that describes secure configuration of the device; or a specific indication that there are no secure configuration steps that apply {For Government Reference Only: relates to CCI-003124}
- b. Documentation that describes effective use and maintenance of security functions or mechanisms for the device; or a specific indication that there are no security functions or mechanisms in the device {For Government Reference Only: relates to CCI-003127}
- c. For devices which include a user interface, documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {For Government Reference Only: relates to CCI-003130}

1.8.8.3 Default Requirements for Control System Devices

For control system devices where Control System Cybersecurity Documentation requirements are not otherwise indicated in this Section, provide:

- a. Documentation that describes secure configuration of the device {For Government Reference Only: relates to CCI-003124}
- b. Documentation that describes secure installation of the device {For Government Reference Only: relates to CCI-003125}
- c. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}
- d. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government Reference Only: relates to CCI-003127}
- e. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {For Government Reference Only: relates to CCI-003128}
- f. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms {For Government Reference Only: relates to CCI-003129}
- g. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {For Government Reference Only: relates to CCI-003130}
- h. Documentation that describes user responsibilities in maintaining the security of the device {For Government Reference Only: relates to CCI-003131}
- i. Documentation of the published last date of support by the manufacturer or indication that a published date is not available. {For Government Reference Only: relates to CCI-003374}

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.9 SOFTWARE LICENSING

{For Government Reference Only: This subpart (and its subparts) relates to SI-2(a), SI-2(c), SI-7(14); CCI-001227, CCI-002605, CCI-002737}

For all software provided that has not already been licensed to the government or project site, provide a license to the Government for a period of no less than 5 years, and the license must also include the following software updates:

- a. Security and bug-fix patches issued by the software manufacturer.
- b. Security patches to address any vulnerability identified in the National Vulnerability Database at <http://nvd.nist.gov> with a Common Vulnerability Scoring System (CVSS) severity rating of MEDIUM or higher.

Provide a single Software Licenses submittal with documentation of the software licenses for all software provided

1.10 CYBERSECURITY DURING CONSTRUCTION

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, CA-3; CCI-000258}

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

1.10.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. Contractor computers connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.10.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

1.10.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates, and must use the latest definitions file. Computers used on this project must perform a full antivirus scan at least once per day. Computers which have connected to any other network since the last full antivirus scan must perform a full antivirus scan prior to connection to the control system network or to the temporary contractor-installed IP network. Perform an antivirus scan on all removable media (e.g., external hard drives, CDs, DVDs, USB flash drives) prior to connecting to the control system environment.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.10.1.3 Passwords and Passphrases

The passwords and passphrases for computers, applications, and web-based applications supporting passwords must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.10.1.4 User-Based Authentication

Each user must have a unique account; sharing of a single account between multiple users is prohibited.

1.10.1.5 Demonstration of Compliance

The Government has the right to require demonstration of computer compliance with these requirements at any time during the project.

1.10.1.6 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using contractor owned computers. Contractor Computer Cybersecurity Compliance Statements must use the template published at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1> Each Statement must be signed by a cybersecurity representative for the relevant company.

1.10.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.10.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than those specifically provided or furnished for this project. Any and all access to the network from outside the project site is prohibited.

1.10.3 Government Access to Network

Government personnel must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification.

1.10.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks, when permitted, must not interfere with existing wireless networks, must use WPA2 security and must not broadcast the network name (SSID). Network names (SSID) for wireless networks must be changed from their default values.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.10.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.10.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. Contractor Temporary Network Cybersecurity Compliance Statements must use the template published at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1> Each Statement must be signed by a cybersecurity representative for the relevant company. If no temporary IP networks will be used, provide a single copy of the Statement indicating this.

1.11 CYBERSECURITY DURING WARRANTY PERIOD

All work performed on the control system after acceptance must be performed using Government Furnished Equipment or equipment specifically and individually approved by the Government.

PART 2 PRODUCTS

All products used on this project must meet the indicated requirements, but not all products specified here will be required by every project.

2.1 ETHERNET SWITCH

Provide Open Systems Interconnection (OSI) Layer 2 Ethernet switches with the following capabilities, and with an interface to support switch configuration for these capabilities:

2.1.1 Required Functionality

Switches must:

- a. Copper Ethernet ports must auto negotiate for 10, 100 and 1000 megabits-per-second links.
- b. Be capable of implementing port level access control by MAC address and limit the number of MAC addresses to one MAC address per port.
- c. For MODERATE Impact Systems, be capable of implementing per-port access control lists (ACLs) where the list can be filtered by source and destination IP addresses, and by source and destination UDP or TCP ports.
- c. For LOW Impact Systems, be capable of implementing per-port access control lists (ACLs) where the list can be filtered by source and destination IP addresses, and by source and destination UDP or TCP ports.
- d. Support Remote Network Monitoring (RMON) Port Analysis in accordance with IETF RFC 2819
- e. Configure target port and analysis port such that switch clones all

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

target port traffic to analysis port.

- f. Support authentication via RADIUS server (for management and 802.1x)

2.1.2 Configuration Requirements

Switches must:

- a. Support configuration save and restore.
- b. Support both manual IP address assignment and acquisition of a dynamic IP address via Dynamic Host Configuration Protocol (DHCP).
- c. Be capable of limiting access for configuration to one or more of: a web interface using HTTPS, a command line interface using SSH, or an SNMP connection using SNMP version 3 or later.

2.2 DAISY CHAIN IP CONTROLLERS

Controllers used as Daisy Chain IP Controllers must be IP controllers with exactly two Ethernet network connections and basic built-in switch capabilities to allow implementation of an Ethernet network in a daisy chain architecture. Switches incorporated by Daisy Chain IP Controllers are not required to meet the requirements for Ethernet Switches as defined in this Section.

2.3 DATABASE AND WEB SERVER SOFTWARE FOR MODERATE IMPACT SYSTEMS

{For Government Reference Only: This subpart (and its subparts) relate to RA-5(1), RA-5(5); CCI-001062, CCI-001067, CCI-001645, CCI-002906}

All computer-based databases must use Microsoft SQL Server, Oracle or MySQL. All computer-based web interfaces must use Internet Information Services (IIS) or Apache as the web server.

PART 3 EXECUTION

3.1 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES

Install, configure, and harden all hardware and software furnished on this project in accordance with manufacturer provided documentation, procedures, or methods for secure configuration or installation. Do not implement specific hardening actions if that action would conflict with required functionality or another requirement of this Section.

3.2 NETWORK REQUIREMENTS

3.2.1 Information Flow Enforcement In MODERATE Impact Systems

{For Government Reference Only: This subpart (and its subparts) relate to AC-4; CCI-001368, CCI-001414, CCI-001548, CCI-001549, CCI-001550, CCI-001551}

Install and configure Ethernet switches to block all traffic on all ports not required by the control protocol.

3.2.2 Wireless and Wired Broadcast Communication

{For Government Reference Only: This subpart (and its subparts) relates

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

to AC-18, AC-18(3); CCI-001438, CCI-001439, CCI-002323, CCI-001441, CCI-001449}

Unless explicitly authorized by the Government, do not use any wireless or wired broadcast communication.

3.2.2.1 Wireless and Wired Broadcast IP Communications

Do not install wireless or wired broadcast IP networks, including: do not install a wireless access point; do not install or configure an ad-hoc wireless network; do not install or configure a WiFi Direct communication.

When explicitly authorized by the Government, wireless IP communication may be used to communicate with an existing wireless network.

3.2.2.2 Non-IP Wireless Communication

For LOW Impact Systems: When non-IP wireless communication is explicitly authorized by the Government, use the maximum level of encryption supported by the specific protocol employed and select signal strength and radiated power to the minimum necessary for reliable communication.

For MODERATE Impact Systems: When non-IP wireless communication is explicitly authorized by the Government, the radios must meet NIST FIPS 140-2 Level 2.

3.2.2.3 Wireless and Wired Broadcast Communication Request

Provide a report documenting the proposed use of wireless or wired broadcast communication prior to device selection using the Wireless and Wired Broadcast Communication Request Schedule at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1>. If there is no proposed use of wireless or wired broadcast communication, provide a document indicating this instead of the Request Schedule.

For each device proposed to use wireless or wired broadcast communication show: the device identifier, a description of the device, the location of the device, the device identifiers of other devices communicating with the device, the protocol used for communication, encryption type and strength. For wireless communication, also show: RF Frequency, Radiated Power in dBm (decibel with a milliwatt reference), free-space range, and the expected as-installed range.

3.2.3 Non-IP Control Networks

When control system specifications require particular communication protocols, use only those communication protocols and only as specified. Do not implement any other communication protocol.

When control system specifications do not indicate requirements for communication protocols, use only those protocols required for operation of the system as specified.

3.2.4 IP Control Networks

{For Government Reference Only: This subpart relates to CM-6(a), CM-7(a), CM-7(b), CM-7(1)(b), SC-41; CCI-001588, CCI-000381, CCI-000380, CCI-000381, CCI-000382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546. For Moderate Impact Systems, this subpart (and its subparts)

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

also relates to SC-5(1), SC-5(2); CCI-001094 CCI-001095}

IP Networks must be Ethernet networks and must use switches which are Ethernet Switches or Daisy Chain IP Controllers as defined in this Section. Do not use nonsecure functions, ports, protocols and services as defined in DODI 8551.01 unless those ports, protocols and services are specifically required by the control system specifications or otherwise specifically authorized by the Government. Do not use ports, protocols and services that are not specified in the control system specifications or required for operation of the control system.

For MODERATE Impact Systems, unless explicitly authorized, do not use IP networks if the same control functionality is available through the use of non-IP networks.

3.2.4.1 IP Network Routers

Do not install any device that performs IP routing.

3.2.4.2 IP Devices With Multiple Ethernet Connections

Except for Ethernet Switches and Daisy Chain IP Controllers, devices must not have more than one Ethernet connection to IP networks unless doing so is required by the project specifications and the specific application is approved. If a device with Multiple Ethernet Connections to IP networks is required, provide a Multiple Ethernet Connection Device Request using the Multiple Ethernet Connection Device Request Template at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1> to request approval for each device. If a device with Multiple Ethernet Connections to IP networks is not required, instead provide a document stating that no approval is being requested.

3.2.5 Cryptographic Protection

{For Government Reference Only: This subpart relates to IA-2(9), IA-3(1), SC-8, SC-13, SC-23(1), SC-23(3); CCI-001942, CCI-001959, CCI-001967, CCI-002418, CCI-002449, CCI-002450, CCI-001185, CCI-001188, CCI-001664.}

All remote user interfaces must use HTTPS for all traffic between the user interface client and user interface server.

3.2.6 Device Identification and Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-3; CCI-000777, CCI-000778, CCI-001958. For MODERATE Impact systems, this subpart (and its subparts) also relates to SC-23, SC-23(5); CCI-001184, CCI-002470.}

All computers must support IEEE 802.1x for device authentication to the network.

3.2.6.1 For HVAC Control System Devices

Devices using HTTP as a control protocol must use HTTPS instead.

3.2.6.2 Default Requirements for Control System Devices

For control system devices where Device Identification and Authentication requirements are not otherwise indicated in this Section: Devices using

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

HTTP as a control protocol must use HTTPS instead.

3.2.7 Cryptographic Module Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-7; CCI-000803}

For devices (including but not limited to NIST FIPS 140-2 compliant radios) that have STIG/SRGs related to cryptographic module authentication (CCI-000803), comply with the requirements of those STIG/SRGs.

3.3 ACCESS CONTROL REQUIREMENTS

3.3.1 User Accounts

{For Government Reference Only: This subpart (and its subparts) relate to AC-2(a), AC-3, AC-6(1), AC-6(10), AC-6(2), AC-6(9), CM-11(2), and IA-2; CCI-002110, CCI-000213, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-001812, and CCI-000764.

For MODERATE Impact systems, this subpart (and its subparts) also relate to AC-2 (2), AC-2(3), AC-2(4), AC-6(1), and CM-5(1); CCI-001361, CCI-000017, CCI-000217, CCI-000018, CCI-001403, CCI-001404, CCI-001405, CCI-002130, CCI-001683, CCI-001684, CCI-001685, CCI-001686, CCI-002132, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-001813.}

Any user interface supporting user accounts (either FULLY or MINIMALLY) must limit access according to specified limitations for each account. Install and configure any device having a STIG or SRG in accordance with that STIG or SRG.

All user interfaces FULLY supporting accounts must implement user-based authentication where each account is uniquely assigned to a specific user. User interfaces FULLY supporting accounts must implement at least three (3) levels of user account privilege including: 1) an account with read-only permissions 2) an account with full permissions including account creation and modification and 3) an account with greater permissions than read-only but without account creation and modification. Disable any unnecessary or unused accounts. Disable any "guest-level" accounts that are created on the system by default.

3.3.1.1 Computers

All computer operating systems must FULLY support user accounts and implement accounts for access. Each control system software application not supporting accounts and running on a computer must be installed such that use of the software is restricted by the computer operating system to specific users.

Applications running on computers must not require the user be logged in to a computer operating system administrator account for normal operation. It is permissible to require the computer operating system administrator account for initial application installation and configuration.

3.3.1.2 Controllers

For user interfaces provided by controllers, provide access control in accordance with the User Interface Requirements table for the applicable control system and user interface type.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- a. For table entries of "NA": NA means Not Applicable, there are no interfaces in this category.
- b. For table entries of "None Required": The user interface is not required to support user accounts.
- c. For table entries of "MINIMALLY": The user interface must at least MINIMALLY support user accounts.
- d. For table entries of "FULLY": The user interface must at FULLY support user accounts.
- e. For table entries of "KEY": The user interface must have physical security in the form of either a key lock on the interface itself or be furnished inside a lockable enclosure. Where this is required for a read only interface, the lockable enclosure must prevent viewing of data on the interface; for other interfaces, this lockable enclosure must prevent using the interface to alter data.
- f. For table entries of "Physical Security": For Local FULL interfaces, the interface must be located inside mission space. For Local Limited (not FULL) interfaces, the user interface must either a) be located within mission space or b) be protected by physical security at least as good as the control devices (and equipment controlled by the control devices) affected by the interface. For purposes of this requirement, 'affected' includes controllers with data that can be directly altered by the interface, as well as mechanical and/or electrical equipment directly controlled by those controllers, but does not include other interactions.
- g. Entries of the form "X and Y" must meet both the requirement indicated for X and the requirement indicated for Y. For example, an entry of "MINIMALLY and Physical Security" indicates the user interface must both MINIMALLY support accounts and have physical security.
- h. Entries of the form "X or Y" must meet either the requirement indicated for X or the requirement indicated for Y.

3.3.1.2.1 HVAC Control Systems

User Interface Requirements for LOW Impact HVAC Control Systems	
<u>User Interface Type</u>	<u>Access Control Requirement</u>
Local Read Only (see note 1)	None Required
Local Limited, Non-privileged	None Required
Local Limited, Privileged	MINIMALLY
Local Full	MINIMALLY
Remote Read Only	None Required
Remote Limited, Non-Privileged	MINIMALLY

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

User Interface Requirements for LOW Impact HVAC Control Systems	
<u>User Interface Type</u>	<u>Access Control Requirement</u>
Remote Limited, Privileged AND Remote Full (see note 2)	FULLY
Notes: 1)Local Read Only User Interfaces are always Non-Privileged 2)Remote Full User Interfaces are always Privileged	
User Interface Requirements for MODERATE Impact HVAC Control Systems	
<u>User Interface Type</u>	<u>Access Control Requirement</u> (See note 3)
Local Read Only (see note 1)	None Required
Local Limited, Non-privileged	None Required
Local Limited, Privileged	MINIMALLY and Physical Security
Local Full	MINIMALLY and Physical Security
Remote Read Only	None Required
Remote Limited, Non-Privileged	FULLY
Remote Limited, Privileged AND Remote Full (see note 2)	FULLY
Notes: 1)Local Read Only User Interfaces are always Non-Privileged 2)Remote Full User Interfaces are always Privileged 3)Devices outside mission space require physical security protections as indicated (in "PHYSICAL SECURITY IN MODERATE IMPACT SYSTEMS")	

3.3.1.2.2 Default Requirements for Other Control Systems

For control system devices where User Interface Requirements are not otherwise indicated in this Section, use the Default User Interface Requirements tables.

Default User Interface Requirements for LOW Impact Control Systems	
<u>User Interface Type</u>	<u>Access Control Requirement</u>
Local Read Only (see note 1)	None Required
Local Limited, Non-privileged	None Required

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Default User Interface Requirements for LOW Impact Control Systems	
<u>User Interface Type</u>	<u>Access Control Requirement</u>
Local Limited, Privileged	MINIMALLY
Local Full	MINIMALLY
Remote Read Only	None Required
Remote Limited, Non-Privileged	MINIMALLY
Remote Limited, Privileged AND Remote Full (see note 2)	FULLY
Notes: 1)Local Read Only User Interfaces are always Non-Privileged 2)Remote Full User Interfaces are always Privileged	
Default User Interface Requirements for MODERATE Impact Control Systems	
<u>User Interface Type</u>	<u>Access Control Requirement</u> (See note 3)
Local Read Only (see note 1)	None Required
Local Limited, Non-privileged	None Required
Local Limited, Privileged	MINIMALLY and Physical Security
Local Full	MINIMALLY and Physical Security
Remote Read Only	None Required
Remote Limited, Non-Privileged	FULLY
Remote Limited, Privileged AND Remote Full (see note 2)	FULLY
Notes: 1)Local Read Only User Interfaces are always Non-Privileged 2)Remote Full User Interfaces are always Privileged 3)Devices outside mission space require physical security protections as indicated (in "PHYSICAL SECURITY IN MODERATE IMPACT SYSTEMS")	

3.3.1.3 Additional User Account Expiration Requirements In MODERATE Impact Systems:

In addition to other user account requirements, user account expiration and auditing must be configured as indicated.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.3.1.3.1 For Control System Applications Running on Computers

If temporary accounts are supported, expire temporary accounts 72 hours after creation. Expire all other accounts after 35 days of inactivity.

3.3.1.3.2 For Other Control System Devices FULLY Supporting Accounts

If temporary accounts are supported, expire temporary accounts 72 hours after creation. Expire all other accounts after 365 days of inactivity.

3.3.2 Unsuccessful Logon Attempts

{For Government Reference Only: This subpart (and its subparts) relate to AC-7 (a), AC-7 (b); CCI-000043, CCI-000044, CCI-001423, CCI-002236, CCI-002237, CCI-002238}

Except for high availability user interfaces indicated as exempt, devices must meet the indicated requirements for handling unsuccessful logon attempts. If a device cannot meet these requirements, document device capabilities to protect from subsequent logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures in lieu of the indicated requirements without explicit permission from the Government. If no Device Account Lock Exceptions are requested, provide a document stating that no approval is being requested as the Device Account Lock Exception Request.

3.3.2.1 Devices MINIMALLY Supporting Accounts

For LOW Impact Systems: Devices which MINIMALLY (but not FULLY) support accounts are not required to lock based on unsuccessful logon attempts.

For MODERATE Impact Systems: Devices which MINIMALLY (but not FULLY) support accounts must lock the user account after five consecutive failed login attempts and must unlock the user account after 60 minutes have elapsed without an unsuccessful login attempt or by a successful login to a separate administrator account.

3.3.2.2 Devices FULLY Supporting Accounts

Devices which FULLY support accounts must meet the following requirements.

- a. It must lock the user account when three unsuccessful logon attempts occur within a 15 minute interval.
- b. Once an account is locked, the account must stay locked until unlocked by an administrator. If the account being locked is the sole administrator account on the device, the account must stay locked for 1 hour and then automatically unlock.
- c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.3.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

The following high availability interfaces are exempt from unsuccessful logon attempts requirements:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements		
User Interface	Location	Action to take in lieu of locking screen
Any local UI for DDC controllers	ANY	Please validate action with ISO/ISSM

3.3.3 System Use Notification

{For Government Reference Only: This subpart (and its subparts) relates to AC-8; CCI-000048, CCI-002247, CCI-002243, CCI-002244, CCI-002245, CCI-002246, CCI-000050, CCI-002248}

3.3.3.1 System Use Notification for Remote User Interfaces

Remote user interfaces must display a warning banner meeting the requirements of DTM 08-060 on screen.

3.3.3.2 System Use Notification for Local User Interfaces

Devices which are connected to a network and have a local user interface must display a warning banner meeting the requirements of DTM 08-060 on the user interface screen if capable of doing so and must have a permanently affixed label with an approved banner from DTM 08-060 if unable to display the warning banner on the screen. Where it is impractical (perhaps due to device size) to affix the label to the device, affix the label to the device enclosure.

Labels must be machine printed or engraved, plastic or metal, designed for permanent installation, must use a font no smaller than 14 point, and must provide a high contrast between font and background colors.

3.3.4 Session Lock and Session Termination Requirements In MODERATE Impact Systems:

{For Government Reference Only: This subpart (and its subparts) relates to AC-11(a), AC-11(b), AC-11(1), AC-12, SC-10; AC-10; CCI-000058, CCI-000059, CCI-000056, CCI-000057, CCI-000060, CCI-002360, CCI-002361, CCI-001133, CCI-001134, CCI-000054, CCI-000055, CCI-002252}

3.3.4.1 Session Termination

When session termination is required for a User Interface, the User Interface must implement session termination a) based on manual initiation, or b) based on lack of activity, or c) based on either manual initiation or lack of activity, as indicated.

Session Termination must result in logging out the user. A logged out User Interface may only perform actions as indicated in the "Permitted Actions Without Identification or Authentication" subpart of this Section

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

or display a publicly viewable image or blank screen. User Interfaces must remain logged out (session terminated) until a user enters correct authentication information, which must initiate a new session. All User Interfaces running on computers and all Remote User Interfaces must also terminate network connections as part of session termination.

3.3.4.2 Session Lock

When session lock is required for a User Interface, the User Interface must implement session lock a) based on manual initiation, or b) based on lack of activity, or c) based on either manual initiation or lack of activity, as indicated.

Session lock must result in the User Interface being suspended and the user interface must display a publicly viewable image or blank screen. No interaction with the user interface must be possible until either a) the same user enters valid authentication information, in which case that session must be continued, or b) until a different user enters valid authentication information at which point the first session must be terminated and a new session initiated for the new user.

3.3.4.3 Session Lock and Termination for Computers

User Interface sessions provided by computer operating systems must support the requirement for both Session Lock and Session Termination. Session Lock and Session Termination must be capable of being initiated by the user and must also be initiated by lack of activity. Session Lock must occur after 15 minutes of inactivity, and Session Termination must occur after 30 minutes total of inactivity (including, not in addition to, the time for Session Lock). When a user initiates a new session, terminate existing sessions if necessary to limit the total number of concurrent sessions to 1.

Other User Interface sessions running on computers (for local user interfaces) or hosted on a computer (for remote user interfaces) and supporting accounts must support user initiation of Session Termination and session lock. Session lock may be initiated by user initiation or automatically after 15 minutes of inactivity. In addition, remote User Interface sessions must also initiate Session Termination after 30 minutes of inactivity unless otherwise indicated in the Session Lock and Termination Exceptions table.

3.3.4.4 Session Lock and Termination for Controllers

Writable Remote User Interfaces must support requirements for Session Termination, and must both be capable of being initiated by the user and initiated by lack of activity. Session Termination must initiate after 30 minutes of inactivity.

Local User Interfaces supporting accounts must support manual initiation of Session Termination. Privileged Local User Interfaces must also support timed initiation of Session Termination, with Session Termination initiated at 30 minutes of inactivity. They must also support session lock, where session lock may be initiated by user initiation or automatically after 15 minutes of inactivity.

3.3.5 Permitted Actions Without Identification or Authentication

{For Government Reference Only: This subpart (and its subparts) relates

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

to AC-14; CCI-000061, CCI-000232}

The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.

3.3.6 Physical Security in MODERATE Impact Systems

{For Government Reference Only: This subpart relates to PE-3(1), PE-4, PE-5, SC-7(a), SC-7(c), SC-8, SC-8(1); CCI-000928, CCI-002926, CCI-000936, CCI-002930, CCI-002931, CCI-000937, CCI-001097, CCI-001109, CCI-002418, CCI-002419, CCI-002421.}

3.3.6.1 Physical Security for Media

3.3.6.1.1 Physical Security for Media Inside Mission Space

Install all non-IP network media located inside of the mission space in conduit. Install all IP network media located inside of the mission space in intermediate metallic conduit.

3.3.6.1.2 Physical Security for Media Outside Mission Space

Install all network media (both IP and non-IP) located outside of the mission space in rigid metallic conduit.

3.3.6.2 Physical Security for Devices

Install all devices (computers and controllers) which are located outside of mission space in lockable enclosures. (Recall that per definition of mission space, a room controlled by the mission is mission space regardless of whether it is contiguous with other mission space.)

Install all controllers connected to an IP network in lockable enclosures (both inside and outside of mission space).

3.3.6.3 Physical Security for User Interfaces

Physical security requirements for User Interfaces are specified in the preceding paragraphs of this Section.

3.3.7 Enclosures

Prior to final acceptance of the system, lock all lockable enclosures. Submit an Enclosure Keys submittal with all copies of keys for all enclosures and a key inventory list documenting all keys. Label each key with the matching enclosure identifier.

3.4 USER IDENTIFICATION AND AUTHENTICATION

{For Government Reference Only: This subpart (and its subparts) relates to IA-2, IA-2(1), IA-2(12), IA-5 IA-5(b), IA-5(c), IA-5(e), IA-5(g), IA-5(1), IA-5(11); CCI-000764, CCI-000765, CCI-001953, CCI-001954, CCI-001544, CCI-001989, CCI-000182, CCI-001610, CCI-000192, CCI-000193, CCI-000194, CCI-000205, CCI-001619, CCI-001611, CCI-001612, CCI-001613, CCI-001614, CCI-000195, CCI-001615, CCI-000196, CCI-000197, CCI-000199, CCI-000198, CCI-001616, CCI-001617, CCI-000200, CCI-001618, CCI-002041, CCI-002002, CCI-002003. For MODERATE Impact systems, this subpart also relates to AC-6 (1), AC-6(10), AC-6(2), AC-6(9)-IA-2(4), IA-5(13);

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039,
CCI-001419, CCI-002234, CCI-000768, CCI-002007.}

This subpart indicates requirements for specific methods of identification and authentication for users and user accounts. Where these requirements conflict apply the following order of precedence: 1) If present, Device Specific Requirements take precedence over any other requirements; and then 2) multifactor authentication requirements take precedence over password requirements.

3.4.1 User Identification and Authentication for All System Types

Unless otherwise indicated, all user interfaces supporting accounts (either FULLY or MINIMALLY) must implement Identification and Authorization via passwords.

For MODERATE Impact Systems: Software running on computers and computer operating systems must manage cached authenticators in accordance with the relevant STIGs. All other devices and software must not use cached authenticators.

3.4.2 User Identification and Authentication for Specific System Types

System specific requirements are in addition to and supersede those indicated for all system types. When no additional requirements are indicated for a specific system type the requirements for all systems still apply to that system type.

3.4.2.1 HVAC Control Systems Devices

No additional system specific requirements apply.

3.4.3 User Identification and Authentication for Specific Devices

There are no additional device specific user interface requirements

3.4.4 Implementation of Identification and Authorization Requirements

Identification and Authorization must be met by one of the following methods:

- a. Direct implementation in the user interface.
- b. For user interfaces on a computer: inheriting the Identification and Authorization from the computer operating system, either by the operating system limiting access to specific applications by user, or by the application itself having permissions based on the user logged into the computer.
- c. For remote interfaces: an implementation shared between the remote user interface server and the remote user interface client. For example, a requirement for PIV authentication may be met on a remote user interface by a PIV reader on a web browser client which sends the authentication information via HTTPS to the remote server.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.4.5 Password-Based Authentication Requirements

3.4.5.1 Passwords for Software and Applications Running on Computers

All software and applications running on computers supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character. The list of supported special characters must include at least 4 separate characters.
- f. Password must have a minimum lifetime of 24 hours.
- g. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- h. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters (where location is significant, a character may be reused if it is in a different position).
- i. Passwords must be cryptographically protected during storage and transmission.

3.4.5.2 Passwords for Controllers FULLY Supporting Accounts

All controllers FULLY supporting accounts and supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character. The list of supported special characters must include at least 4 separate characters.
- f. Password must have a maximum lifetime of sixty (60) days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters.
- h. Passwords must be cryptographically protected during storage and transmission.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.4.5.3 Passwords for Remote Interfaces

Passwords for connecting to a Remote User Interface supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character. The list of supported special characters must include at least 4 separate characters.
- f. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters (where location is significant, a character may be reused if it is in a different position).
- h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.4 Passwords for Devices Minimally Supporting Accounts

Devices MINIMALLY supporting accounts must support passwords with a minimum length of four characters.

3.4.5.5 Password Configuration and Reporting

For all devices with a password, change the password from the default password. Coordinate selection of passwords with the Password Point of Contact. Do not use the same password for more than one device unless specifically instructed to do so. Provide a Confidential Password Report documenting the password for each device and describing the procedure to change the password for each device.

Do not provide the Password Summary Report in electronic format. Provide two hardcopies of the Password Summary Report, each copy in its own sealed envelope.

3.4.6 Authenticator Feedback

{For Government Reference Only: This subpart relates to IA-6; CCI-000206}

Devices must never show authentication information, including passwords, on a display. Devices that momentarily display a character as it is entered, and then obscure the character, are acceptable. For devices that have STIGs or SRGs related to obscuring of authenticator feedback (CCI-000206), comply with the requirements of those STIGs/SRGs.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.5 CYBERSECURITY AUDITING

Where an auditing requirement exists for email notification, notify via email the application administrator and Information System Security Officer (ISSO) of the event. Coordinate with the Email Address Point of Contact for email addresses. If outgoing email is not available to the system, disable email notifications.

3.5.1 Audit Events, Content of Audit Records, and Audit Generation

{For Government Reference Only: This subpart (and its subparts) relates to AU-2(a), AU-2(c), AU-2(d), AU-3, AU-10, AU-12, AU-14(b), AU-14(1), AU-14(2), AU-14(3), CM-5(1), SC-7 (9); CCI-000123, CCI-001571, CCI-000125, CCI-001485, CCI-000130, CCI-000131, CCI-000132, CCI-001230, CCI-000133, CCI-000134, CCI-001487, CCI-000166, CCI-001899, CCI-000169, CCI-001459, CCI-000171, CCI-000172, CCI-001910, CCI-001914, CCI-001919, CCI-001464, CCI-001462, CCI-001920, CCI-001814, CCI-002400. For MODERATE Impact systems, this subpart (and its subparts) also relates to AU-3 (1); CCI-000135, CCI-001488}

For devices that have STIG/SRGs related to audit events, content of audit records or audit generation, comply with the requirements of those STIG/SRGs.

If auditing requirements can be met using existing control system alarm or event capabilities, those existing capabilities may be used to meet these requirements.

3.5.1.1 Computers

For each computer, provide the capability to select audited events and the content of audit logs. Configure computers to audit the indicated events, and to record the indicated information for each auditable event. Send logs to a syslog server that is only accessible via accounts on the system with privileged level access.

3.5.1.1.1 Audited Events

Configure each computer to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)
- b. Successful and unsuccessful logon attempts
- c. Successful logouts
- d. Privileged activities or other system level access
- e. Concurrent logons from different workstations
- f. Successful and unsuccessful accesses to objects
- g. Program initiations
- h. Direct access to the information system

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- i. Account creations, modifications, disabling, and terminations. For MODERATE Impact Systems, also provide email notification when these audit events occur.
- j. Kernel module load, unload, and restart

3.5.1.1.2 Audit Event Information To Record

Configure each computer to record, for each auditable event, the following information (where applicable to the event):

- a. What type of event occurred
- b. When the event occurred
- c. Where the event occurred
- d. The source of the event
- e. The outcome of the event
- f. The identity of any individuals or subjects associated with the event
- g. For MODERATE Impact Systems: For all privileged commands, full-text recording of the executed command and the user executing the command

For MODERATE Impact Systems: Audit records must provide sufficient detail to reconstruct events to determine cause of compromise and magnitude of damage, malfunction, or security violation.

3.5.1.2 For HVAC Control System Controllers

3.5.1.2.1 HVAC Control System Controllers FULLY Supporting User Accounts

For each controller which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure controllers to audit the indicated events, and to record the indicated information for each auditable event.

3.5.1.2.1.1 Audited Events

Configure each controller to audit the following events:

- a. Successful and unsuccessful logon attempts to the controller
- b. Successful logouts
- c. All account creations, modifications, disabling, and terminations. For MODERATE Impact Systems, also provide email notification when these audit events occur.
- d. All controller shutdown and startup
- e. For privileged user interfaces in MODERATE Impact Systems: All user commands.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.5.1.2.1.2 Audit Event Information To Record

Configure each controller to record, for each auditable event, the following information (where applicable to the event):

- a. what type of event occurred
- b. when the event occurred
- c. the identity of any individuals or subjects associated with the event
- d. For privileged user interfaces in MODERATE Impact Systems: Full text recording of the executed command and the user executing the command.

For MODERATE Impact Systems: Audit records must provide sufficient detail to reconstruct events to determine cause of compromise and magnitude of damage, malfunction, or security violation.

3.5.1.2.2 Other HVAC Control System Controllers

There are no requirements to perform auditing at HVAC field controllers that do not FULLY support accounts.

3.5.1.3 Default Requirements for Control System Controllers

For control system controllers where Audit Events, Content of Audit Records, and Audit Generation are not otherwise indicated in this Section:

3.5.1.3.1 Controllers Which FULLY Support Accounts

For each controller which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure controllers to audit the indicated events, and to record the indicated information for each auditable event.

3.5.1.3.1.1 Audited Events

Configure each controller to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)
- b. Successful and unsuccessful logon attempts
- c. Successful logouts
- d. Concurrent logons from different workstations
- e. All account creations, modifications, disabling, and terminations. For MODERATE Impact Systems, also provide email notification when these audit events occur.
- f. All kernel module load, unload, and restart
- g. For privileged user interfaces in MODERATE Impact Systems: All user commands.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.5.1.3.1.2 Audit Event Information To Record

Configure each controller to record, for each auditable event, the following information (where applicable to the event):

- a. what type of event occurred
- b. when the event occurred
- c. where the event occurred
- d. the source of the event
- e. the outcome of the event
- f. the identity of any individuals or subjects associated with the event
- g. For privileged user interfaces in MODERATE Impact Systems: Full text recording of the executed command and the user executing the command.

For MODERATE Impact Systems: Audit records must provide sufficient detail to reconstruct events to determine cause of compromise and magnitude of damage, malfunction, or security violation

3.5.1.3.2 Controllers Which Do Not FULLY Support Accounts

For each controller which does not FULLY support accounts configure the controller to audit all controller shutdown and startup events and to record for each event the type of event and when the event occurred.

3.5.2 Audit Time Stamps

{For Government Reference Only: This subpart (and its subparts) relates to AU-8; CCI-000159, CCI-001889, CCI-001890. For MODERATE Impact systems, this subpart (and its subparts) also relates to AU-8 (1); CCI-001891, CCI-001892, CCI-002046.}

Any device (computer or controller) generating audit records must have an internal clock capable of providing time with a resolution of one second. Clocks must not drift more than 10 seconds per day. Configure the system so that each device (computer or controller) generating audit records maintains accurate time to within 1 second. Note that if the control system specifications include requirement for clocks, the most stringent requirement applies.

3.5.3 Auditing Front End Software

The project site currently has the following software to support control system auditing: TBD. If there is no existing auditing front end software or the software is not compatible with the provided control systems, provide Auditing Front End Software with audit log import and upload, export, notification, and analysis functionality. The Auditing Front End Software may be provided as a component of the control system front end or as a separate software package, and a single package may serve multiple control systems provided under the same projects if they are sharing a cybersecurity authorization.

When the Auditing Front End Software is neither existing nor installed under the requirements of another Section, furnish the Auditing Front End

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Software media and license. Submit copies of Auditing Front End Software if this function is not part of the software provided with the control system to meet requirements of other Sections.

3.5.3.1 Import and Upload Requirements

Auditing Front End Software must be capable of importing audit logs from the Device Audit Record Upload Software and of uploading audit logs over the network from all control system devices supporting network upload of audit logs.

3.5.3.2 Export Requirements

Auditing Front End Software must be capable of exporting to a file format supported by Microsoft Excel.

3.5.3.3 Notification Of Audit Failure in Devices in MODERATE Impact Systems

The auditing front end software must be capable of receiving notifications of audit failure from control system devices and computers and be able to provide email notification based on receipt of the notification.

3.5.3.4 Audit Reduction and Report Generation In MODERATE Impact Systems

{For Government Reference Only: This subpart (and its subparts) relates to AU-6(4), AU-7(a), AU-7(b), AU-7(1), AU-12(1); CCI-000154, CCI-001875, CCI-001876, CCI-001877, CCI-001878, CCI-001879, CCI-001880, CCI-001881, CCI-001882, CCI-000158, CCI-000173, CCI-000174, CCI-001577.}

Auditing Front End Software must provide audit reduction and reporting capabilities that supports on-demand review and analysis, on demand reporting, and after the fact investigations of security incidents. The software must be able to combine audit records from all components within the system and analyze them as a single audit record. The software must correct for discrepancies in timestamps of audit logs from different sources and be able to account for discrepancies up to 2 seconds between sources. The software must not alter original audit record content or time ordering of audit records. The software must have the capability to filter audit records using user-defined fields within the audit records.

The audit reduction and reporting capabilities may incorporate third party application, such as Excel or Access.

3.5.4 Audit Storage Capacity and Audit Upload

{For Government Reference Only: This subpart (and its subparts) relates to AU-4; CCI-001848, CCI-001849}

The creation of audit records must never interfere with normal device operation. Devices must cease collection of auditing information if required to maintain normal operation.

- a. For devices that have STIG/SRGs related to audit storage capacity (CCI-001848 or CCI-001849) comply with the requirements of those STIG/SRGs.
- b. For controllers capable of generating audit records, provide 60 days worth of secure local storage, assuming 10 auditable events per day.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- c. For computers, provide storage in conformance with applicable STIGs/SRGs.

3.5.4.1 Audit Log Storage Notification In MODERATE Impact Systems

{For Government Reference Only: This subpart (and its subparts) relates to AU-5(1); CCI-001855.}

Controllers storing audit logs must provide notification when audit logs reach 75 percent of capacity either directly through email or indirectly by sending a notification to a computer, and the computer sending an email. Computers storing audit logs must provide notification when audit logs reach 75 percent of capacity directly through email.

3.5.4.2 Device Audit Record Upload Software

For each device (computer or controller) required to audit events and for which audit logs cannot be uploaded over the network by the Auditing Front End Software, provide and license to the Government software implementing a secure mechanism of uploading audit records from the device and exporting them to the Auditing Front End Software. Where different devices use different software, provide software of each type required to upload audit logs from all devices.

Submit copies of device audit record upload software if this function is not part of the software provided with the control system to meet requirements of other Sections. If there are no devices requiring this software, provide a document stating this in lieu of this submittal.

3.5.5 Response to Audit Processing Failures

{For Government Reference Only: This subpart (and its subparts) relates to AU-5; CCI-000139, CCI-000140, CCI-001490.}

In the case of a failure in the auditing system, computers associated with auditing must provide email notification. For MODERATE Impact systems, the computer must also notify the associated auditing front end software. In case of an audit failure, if possible, continue to collect audit records by overwriting existing audit records.

For MODERATE Impact Systems: In the case of an audit failure at a controller performing auditing, the device must notify the associated auditing front end software of the audit failure if able, and must continue to collect audit records by overwriting existing audit records if able. The auditing front end software must provide notification as indicated, treating the notification of failure from the device as a failure in the auditing system.

3.6 REQUIREMENTS FOR LEAST FUNCTIONALITY

{For Government Reference Only: This subpart (and its subparts), along with the Network Communication, Ports, Protocols and Services Report submittal specified elsewhere in this section, relates to CM-6(a), CM-6(c), CM-7, CM-7(1)(b), SC-41; CCI-000363, CCI-000364, CCI-000365, CCI-001588, CCI-001755, CCI-000381, CCI-000380, CCI-000382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546. For MODERATE Impact systems, this subpart (and its subparts) also relates to CM-7(2), CM-7(5)(a), CM-7(5)(b); CCI-000381, CCI-000380, CCI-000382, CCI-001761, CCI-001762}

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I/O access for least functionality), install and configure the device in accordance with that STIG or SRGs.

3.6.1 Device Capabilities

For HVAC Control Systems: Do not provide devices with remote user interfaces or with full user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

For Other Control Systems: For LOW Impact Systems: Do not provide devices with remote user interfaces or with full user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

For Other Control Systems: For MODERATE Impact Systems: Do not provide devices with remote user interfaces or full user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

For all MODERATE Impact Systems: Unless specifically required by the government, do not provide a capability to update device firmware over the network.

3.6.2 Software

For software that has a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port access for least functionality), install and configure the software in accordance with that STIG or SRG.

Do not install software that is not specifically required to meet a contract requirement. Remove any previously installed that is not specifically required to meet a contract requirement. Do not implement functionality within software that is not specifically required to meet contract requirements.

3.7 SYSTEM AND COMMUNICATION PROTECTION

3.7.1 Collaborative Computing

{For Government Reference Only: This subpart relates to SC-15(a), SC-15(b); CCI-001150, CCI-001152.}

Without explicit approval from the project site, control systems must not use collaborative computing technologies.

3.7.2 Denial of Service Protection and Application Partitioning In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to SC-5, SC-12, SC-7(a); CCI-001093, CCI-002385, CCI-002386, CCI-002430, CCI-001097. For MODERATE Impact systems, this subpart also relates to SC-2; CCI-001082.}

To the greatest extent practical, implement control logic without reliance on the network. Except when required to meet the requirements of the

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

control system Section (where the requirement can only be met using computer hardware), do not implement control logic in computers. For MODERATE Impact systems, do not implement control logic in a device providing (i.e. acting as a server for) a Full Remote User Interface.

3.7.2.1 Network Reliance in MODERATE Impact HVAC Control Systems

Except for networked input and outputs on input-output buses specifically designed to provide high reliability or redundancy, sensors and actuators must not rely on the network to exchange data with the controller executing the sequence of operation which uses the sensor value or determines the actuator command.

Sensor values required by multiple devices may be shared over the network provided they are connected to a controller requiring the value for execution of the sequence and that controller shares the value on the network.

3.7.3 Mobile Code In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to SC-18(a), SC-18(b), SC-18(c), SC-18(1), SC-18(3), SC-18(4); CCI-001160, CCI-001161, CCI-001162, CCI-001163, CCI-001164, CCI-001165, CCI-001166, CCI-001662, CCI-002457, CCI-002458, CCI-001169, CCI-001695, CCI-001170, CCI-002469}

Devices with STIGs/SRGs related to Mobile Code and to Security Control SC-18 must be installed in accordance with the relevant STIGs/SRGs. All remote user interfaces must meet the requirements of the "Web Browsers and Application SRG".

Mobile code may only be downloaded from a specifically authorized mobile code repository. Coordinate with the Mobile Code Point of Contact for the location of a repository.

3.7.4 Protection of Information at Rest In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to SC-28, SC-28(1); CCI-001199, CCI-002472, CCI-002475, CCI-002476}

Computers must protect information at rest in accordance with applicable STIGs.

Any control system device storing personally identifiable information (PII), controlled unclassified information (CUI), or classified information must be protected by an Information At Rest encryption solution or by a physical security solution. Provide a Protection of Information At Rest Proposal indicating each device storing PII, CUI, or classified information and the encryption or physical security solution proposed for that device for government approval. If no devices stores PII, CUI, or classified information, provide a document stating this as the Protection of Information At Rest Proposal submittal. Do proceed with device selection and installation until the Protection of Information At Rest Proposal is approved. Once approved, implement approved Information At Rest protections.

3.8 SAFE MODE AND FAIL SAFE OPERATION

{For Government Reference Only: This subpart (and its subparts) relates

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

to CP-12, SI-10(3), SI-17; CCI-002855, CCI-002856, CCI-002857, CCI-002754, CCI-002773, CCI-002774, CCI-002775}

For all control system components with an applicable STIG or SRG, configure the component in accordance with all applicable STIGs and SRGs.

3.9 SYSTEM MAINTENANCE TOOL SOFTWARE

{For Government Reference Only: This subpart (and its subparts) relates to MA-3; CCI-000865.}

Submit and license to the Government all software required to operate, maintain and modify the control system such 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. Submit hard copies of user manuals for each software with the software submittal. Provide any hardware keys or dongles, software keys, license numbers, and other information required to enable the Government to access or change the system.

For software provided and licensed to the Government under the requirements of another Section, submit a statement indicating the Section and Submittal under which the software was provided. For software provided to meet the requirements of this Section and not provided and licensed under another Section, submit software and software user manuals on DVD or CD as a Technical Data Package and submit one hard copy of the software user manual for each piece of software.

3.10 DEVICE POWER

{For Government Reference Only: This subpart (and its subparts) relates to PE-11, PE-11(1); CCI-002955, CCI-000961. For MODERATE Impact systems, this subpart (and its subparts) also relates to PE-9, PE-9(1); CCI-000952, CCI-002953, CCI-002954.}

For LOW Impact Systems: Provide emergency power in accordance with the control system and equipment specification Sections.

For MODERATE Impact Systems: Provide control system with power supply meeting or exceeding the reliability of the controlled equipment. Powering control system devices using the same power source as the equipment controlled by the device is a permissible method of meeting this requirement. Without explicit approval from the government, do not install local uninterruptible power supplies (UPSes) as a source of device power.

3.10.1 Device Behavior on Loss of Power In MODERATE Impact Systems:

Application programs and configuration settings must be stored in devices in manner such that a loss of power does not result in a loss of the application program or configuration settings: Loss of power must never result in the loss of application programs, regardless of the length of time power is lost; and loss of power for less than 2,500 hours must not result in the loss of configured settings.

In the event of a loss of power, when power is restored, controllers and computers executing control logic (and the underlying equipment) must recover and resume their normal sequences of operation. Note that the sequence of operation may require specific actions (e.g. startup

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

sequences) upon recovery from loss of power.

3.11 VULNERABILITY SCANNING

{For Government Reference Only: This subpart (and its subparts) relates to RA-5 RA-5(a), RA-5(b), RA-5(c), RA-5(d); CCI-001054, CCI-001055, CCI-000156, CCI-001641, CCI-001643, CCI-001057, CCI-001058, CCI-001059. For MODERATE Impact systems, this subpart (and its subparts) also relates to RA-5(1), RA-5(5); CCI-001062, CCI-001067, CCI-001645, CCI-002906.}

All IP devices must be scannable, such that the device can be scanned by industry standard IP network scanning utilities without harm to the device, application, or functionality.

3.11.1 Computers and Software Running on Computers

Computers and applications running on computers must meet relevant vulnerability scanning STIGs/SRGs and respond to approved DoD vulnerability scanning tools.

3.11.2 Controllers

Provide controllers that are scannable by standard control system discovery tools or control system browsers and return meaningful status information including the network inputs and outputs for the controller. This information must contain sufficient detail to detect vulnerabilities or exploits of the controller.

Provide all software needed to scan the control system as the Control System Scanning Tools submittal. If the software required to scan the system is already installed at the project site or is provided under a separate section instead provide a statement indicating this.

3.12 FIPS 201-2 REQUIREMENT

{For Government Reference Only: This subpart (and its subparts) relates to SA-4 (10); CCI-003116}

Devices in the following systems which implement PIV must be on the NIST FIPS 201-2 approved product list (<https://www.idmanagement.gov/approved-products-list/>): NONE.

3.13 SYSTEM AND INTEGRATION INTEGRITY

3.13.1 Malicious Code Protection

{For Government Reference Only: This subpart (and its subparts) relates to SI-3(c); CCI-001241, CCI-002623}

For all computers installed under this project, provide malware protection software media, provide licenses, and install and configure malware protection software as indicated. Coordinate with the Government Computer Access Point of Contact as required.

- a. Provide malware protection software licenses.
- b. Provide malware protection software media.
- c. Install and configure malware protection software in accordance with

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

the relevant STIGs.

3.13.2 Software, Firmware, and Information Integrity In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to CM-5(3);
CCI-001749, CCI-002704, CCI-002726}

If there exists Integrity Verification Software that can check boot process, software, firmware, or information in the control system and verify its integrity, provide it. If no such software exists, provide a statement to this affect in lieu of the software.

3.14 CONTROL SYSTEM CYBERSECURITY TESTING

{For Government Reference Only: For MODERATE Impact systems, this subpart (and its subparts) relates to SA-11(a), SA-11(b), SA-11(c), SA-11(d), SA-11(e); CCI-003171, CCI-003172, CCI-003173, CCI-003174, CCI-003175, CCI-003176, CCI-003177, CCI-003178.}

3.14.1 Control System Cybersecurity Testing Procedures

Prepare and submit Control System Cybersecurity Testing Procedures explaining step-by-step, the actions and expected results that will demonstrate that the control system meets the requirements of this Section. The Control System Cybersecurity Testing Procedures may be submitted as a Technical Data Package.

3.14.2 Control System Cybersecurity Testing Execution

Using the Control System Cybersecurity Testing Procedures verify that the control system meets the requirements of this Section. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. If testing reveals deficiencies in the system, correct the deficiency and retest until successful.

3.14.3 Control System Cybersecurity Testing Report

Prepare and submit a Control System Cybersecurity Testing Report documenting all tests performed and their results. Include all tests in the Control System Cybersecurity Testing Procedures and any additional tests performed during testing. Document test failures and repairs conducted with the test results. The Control System Cybersecurity Testing Report may be submitted as a Technical Data Package

3.15 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT

In addition to testing and testing support required by other Sections, provide a minimum of 40 hours of technical support for cybersecurity testing of control systems to support the DoD Risk Management Framework process Cybersecurity assessment of the control system. This support is independent of (and in addition to) the Control System Cybersecurity Testing specified in this section.

3.16 CYBERSECURITY TRAINING

Provide eight hours of classroom and hands-on training for six Government

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

personnel on the cybersecurity operation and maintenance of the control system provided. This training is in addition to and must be coordinated with control system training specified in other Sections.

The Government will provide the training location. Training must cover, at a minimum: (a) applying software and firmware updates, (b) user account creation, modification and deletion, (c) audit log upload procedures and (d) identification of privileged user interfaces and system impact of those interfaces. Training session must include a question and answer period during which government staff questions about cybersecurity aspects of the control system are answered.

-- End of Section --

Control Number	800-53 Control Text Indicator	CCI	CCI Definition	Implementation Guidance	Assessment Procedures	DoD-Defined	Enclave	Designer	Non-Designer	Impractical	Combined Category	UFGS REFERENCE
AC-14	AC-14(a)	CCI-000061	The organization identifies and defines organization-defined user actions that can be performed on the information system without identification or authentication consistent with organizational missions/business functions.	The organization being inspected/assessed identifies, defines, and documents user actions that can be performed on the information system without identification or authentication consistent with organizational missions/business functions. DoD has determined the user actions are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented user actions to ensure the organization being inspected/assessed identifies and defines the user actions that can be performed on the information system without identification and authentication. DoD has determined the user actions are not appropriate to define at the Enterprise level.			X			Designer	3.3.5 Permitted Actions Without Identific...
AU-5	AU-5(a)	CCI-000139	The information system alerts designated organization-defined personnel or roles in the event of an audit processing failure.	The organization being inspected/assessed configures the information system to alert at a minimum, the SCA and ISSO in the event of an audit processing failure. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 139. DoD has defined the personnel or roles as at a minimum, the SCA and ISSO.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed has configured the information system to alert at a minimum, the SCA and ISSO in the event of an audit processing failure. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 139. DoD has defined the personnel or roles as at a minimum, the SCA and ISSO.		X	X		X	Enclave Designer Impractical	3.5.5 Response to Audit Processing Failur...
AU-5	AU-5(b)	CCI-000140	The information system takes organization defined actions upon audit failure (e.g., shut down information system, overwrite oldest audit records, stop generating audit records).	The organization being inspected/assessed configures the information system to take actions as defined in AU-5, CCI 1490 upon audit failure. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 140.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed has configured the information system to take actions as defined in AU-5, CCI 1490 upon audit failure. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 140.		X	X		X	Enclave Designer Impractical	3.5.5 Response to Audit Processing Failur...
AC-14	AC-14(b)	CCI-000232	The organization documents and provides supporting rationale in the security plan for the information system, user actions not requiring identification and authentication.	The organization being inspected/assessed documents supporting rationale in the security plan for the actions defined in AC-14, CCI 61 to not require identification and authentication.	The organization conducting the inspection/assessment obtains and examines the security plan to ensure the organization being inspected/assessed documents the supporting rationale for the actions defined in AC-14, CCI 61 to not require identification and authentication.			X			Designer	3.3.5 Permitted Actions Without Identific...
CA-3	CA-3(b)	CCI-000258	The organization documents, for each interconnection, the interface characteristics.	The organization being inspected/assessed will document the interface characteristics for each interconnection. Use of external reporting databases for these characteristics when tied to the specific interconnection is acceptable (e.g., ports, protocols, and services). Policy Note: Interconnection security agreements are required for systems connecting between enclaves that require the hosting enclave to enable PPS outside of their already established and approved business practices. Connections can include both DoD enclaves or non DoD enclaves.	The organization conducting the inspection/assessment obtains and examines interconnection security agreement documentation. Policy Note: Interconnection security agreements are required for systems connecting between enclaves that require the hosting enclave to enable PPS outside of their already established and approved business practices. Connections can include both DoD enclaves or non DoD enclaves.		X	X	X		Enclave Designer Non-Designer	1.9.2 Cybersecurity Interconnection Sched... 1.11 CYBERSECURITY DURING CONSTRUCTION
CM-6	CM-6(a)	CCI-000363	The organization defines security configuration checklists to be used to establish and document configuration settings for the information system technology products employed.	DoD has defined the security configuration checklists as DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTM's etc.). The organization being inspected/assessed documents in the security plan, the configuration guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTM's etc.) which apply to their information system components.	DoD has defined the security configuration checklists as DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTM's etc.). The organization conducting the inspection/assessment obtains and examines the security plan to ensure the organization being inspected/assessed has documented the configuration guidance which apply to their information system components. The organization conducting the inspection/assessment reviews the list of documented guidance to ensure that all applicable guidance is identified given the information system components within the authorization boundary.			X			Designer	3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
CM-6	CM-6(a)	CCI-000364	The organization establishes configuration settings for information technology products employed within the information system using organization-defined security configuration checklists.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTM's etc.) meet the DoD requirement for establishing configuration settings. DoD Components are automatically compliant with this CCI because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTM's etc.).	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTM's etc.) meet the DoD requirement for establishing configuration settings. DoD Components are automatically compliant with this CCI because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTM's etc.).			X			Designer	3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
CM-6	CM-6(a)	CCI-000365	The organization documents configuration settings for information technology products employed within the information system using organization-defined security configuration checklists that reflect the most restrictive mode consistent with operational requirements.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTM's etc.) meet the DoD requirement for documenting configuration settings. DoD Components are automatically compliant with this CCI because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTM's etc.).	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTM's etc.) meet the DoD requirement for documenting configuration settings. DoD Components are automatically compliant with this CCI because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTM's etc.).	X		X	X	X	DoD-Defined Designer Non-Designer Impractical	3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...

CM-7	CM-7(b)	CCI-000380	The organization defines for the information system prohibited or restricted functions, ports, protocols, and/or services.	DoD has defined the information system prohibited or restricted functions, ports, protocols, and/or services as IAW DoDI 8551.01.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the information system prohibited or restricted functions, ports, protocols, and/or services as IAW DoDI 8551.01.			X				Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
CM-7	CM-7(a)	CCI-000381	The organization configures the information system to provide only essential capabilities.	The organization being inspected/assessed documents in the security plan, essential capabilities which the information system must provide. The organization being inspected/assessed configures the information system to provide only those documented essential capabilities.	The organization conducting the inspection/assessment obtains and examines the security plan to ensure the organization being inspected/assessed has identified essential capabilities. The organization conducting the inspection/assessment inspects the information system to ensure that it provides only those documented essential capabilities.			X				Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
CM-7	CM-7(b)	CCI-000382	The organization configures the information system to prohibit or restrict the use of organization-defined functions, ports, protocols, and/or services.	The organization being inspected/assessed configures the information system to prohibit or restrict the use of functions, ports, protocols, and/or services IAW DoDI 8551.01. DoD has defined the information system prohibited or restricted functions, ports, protocols, and/or services as IAW DoDI 8551.01.	The organization conducting the inspection/assessment inspects the information system to ensure the organization being inspected/assessed prohibits or restricts the use of functions, ports, protocols, and/or services IAW DoDI 8551.01. DoD has defined the information system prohibited or restricted functions, ports, protocols, and/or services as IAW DoDI 8551.01.			X				Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
CM-7(3)	CM-7(3)	CCI-000388	The organization ensures compliance with organization-defined registration requirements for functions, ports, protocols, and services.	The organization being inspected/assessed implements DoDI 8551.01. DoD has defined the registration requirements as IAW DoDI 8551.01.	The organization conducting the inspection/assessment obtains and examines a documented listing of ports, protocols, and services in use, and reviews a sampling of those ports, protocols, and services to ensure the organization being inspected/assessed is compliant with DoDI 8551.01. DoD has defined the registration requirements as IAW DoDI 8551.01.			X	X			Designer Non-Designer	1.9.3 Network Communication Report
CM-8	CM-8(a)(1)	CCI-000389	The organization develops and documents an inventory of information system components that accurately reflects the current information system.	The organization being inspected/assessed documents inventory of information system components that accurately reflects the current information system.	The organization conducting the inspection/assessment obtains and examines the documented inventory and examines a sampling of information system components to ensure inventory accurately reflects the current information system.			X				Designer	1.9.4 Control System Inventory Report
CM-8	CM-8(a)(2)	CCI-000392	The organization develops and documents an inventory of information system components that includes all components within the authorization boundary of the information system.	The organization being inspected/assessed documents inventory of information system components that includes all components within the authorization boundary of the information system.	The organization conducting the inspection/assessment obtains and examines the documented inventory and examines a sampling of information system components to ensure inventory includes all components within the authorization boundary of the information system.			X				Designer	1.9.4 Control System Inventory Report
CM-8	CM-8(a)(4)	CCI-000398	The organization defines information deemed necessary to achieve effective information system component accountability.	DoD has defined the information as hardware inventory specifications (manufacturer, type, model, serial number, physical location), software license information, information system/component owner, and for a networked component/device, the machine name.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the information as hardware inventory specifications (manufacturer, type, model, serial number, physical location), software license information, information system/component owner, and for a networked component/device, the machine name.	X		X	X	X		DoD-Defined Designer Non-Designer Impractical	1.9.4 Control System Inventory Report
CP-10	CP-10	CCI-000550	The organization provides for the recovery and reconstitution of the information system to a known state after a disruption.	The organization being inspected/assessed provides automated mechanisms or manual procedures, or a combination of the two, for the recovery and reconstitution of its information system to a known state after a disruption. The organization must identify the selected method in the contingency plan.	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it identifies the recovery and reconstitution method for its information system to a known state after a disruption.			X	X	X		Enclave Designer Non-Designer	1.9.5 Software and Configuration Backups
CP-10	CP-10	CCI-000551	The organization provides for the recovery and reconstitution of the information system to a known state after a compromise.	The organization being inspected/assessed provides automated mechanisms or manual procedures, or a combination of the two, for the recovery and reconstitution of its information system to a known state after a compromise. The organization must identify the selected method in the contingency plan.	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it identifies the recovery and reconstitution method for its information system to a known state after a compromise.			X	X	X		Enclave Designer Non-Designer	1.9.5 Software and Configuration Backups
CP-10	CP-10	CCI-000552	The organization provides for the recovery and reconstitution of the information system to a known state after a failure.	The organization being inspected/assessed provides automated mechanisms or manual procedures, or a combination of the two, for the recovery and reconstitution of its information system to a known state after a failure. The organization must identify the selected method in the contingency plan.	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it identifies the recovery and reconstitution method for its information system to a known state after a failure.			X	X	X		Enclave Designer Non-Designer	1.9.5 Software and Configuration Backups
IA-3	IA-3	CCI-000777	The organization defines a list of specific and/or types of devices for which identification and authentication is required before establishing a connection to the information system.	DoD has defined the value as all mobile devices and network connected endpoint devices (including but not limited to: workstations, printers, servers (outside a datacenter), VoIP Phones, VTC CODECs).	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the value as all mobile devices and network connected endpoint devices (including but not limited to: workstations, printers, servers (outside a datacenter), VoIP Phones, VTC CODECs).	X		X	X		X	DoD-Defined Enclave Designer Impractical	1.9.4 Control System Inventory Report 3.2.7 Device Identification and Authentic...
IA-3	IA-3	CCI-000778	The information system uniquely identifies an organization defined list of specific and/or types of devices before establishing a local, remote, or network connection.	The organization being inspected/assessed configures the network infrastructure to identify all mobile devices and network connected endpoint devices (including but not limited to: workstations, printers, servers (outside a datacenter), VoIP Phones, VTC CODECs) before establishing a local, remote, network connection. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 778. DoD has defined the value as all mobile devices and network connected endpoint devices (including but not limited to: workstations, printers, servers (outside a datacenter), VoIP Phones, VTC CODECs).	The organization conducting the inspection/assessment examine a sampling of the network infrastructure device configurations to ensure devices connecting to the infrastructure are uniquely identified. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 778.			X	X		X	Enclave Designer Impractical	1.9.4 Control System Inventory Report 3.2.7 Device Identification and Authentic...

MA-3	MA-3	CCI-000865	The organization approves information system maintenance tools.	The organization being inspected/assessed documents the approved maintenance tools within the Security Plan.	The organization conducting the inspection/assessment: 1. obtains and examines the Security Plan to ensure the list of approved maintenance tools is documented; 2. ensures only the approved maintenance tools are used within the system.		X	X		Designer Non-Designer	3.9 SYSTEM MAINTENANCE TOOL SOFTWARE
PE-3(1)	PE-3(1)	CCI-000928	The organization enforces physical access authorizations to the information system in addition to the physical access controls for the facility at organization-defined physical spaces containing one or more components of the information system.	The organization being inspected/assessed will provide documentation of additional physical access authorizations for the facility/facilities at physical spaces containing one or more components of the information system defined in PE-3 (1), CCI 2926. The organization will ensure that these controls are separate from, and independent of, the physical access controls established for the facility.	The organization conducting the inspection/assessment obtains and examines the documented list of additional physical access authorizations for the facility/facilities at physical spaces containing one or more components of the information system. The objective of the examination is to determine if the organization is enforcing additional physical access authorizations to areas of the facility at physical spaces containing one or more components of the information system defined in PE-3 (1), CCI 2926. These controls are independent of the physical access controls established for the facility.		X	X		Designer Non-Designer	3.3.6 Physical Security in MODERATE Impact...
PE-4	PE-4	CCI-000936	The organization controls physical access to organization-defined information system distribution and transmission lines within organizational facilities using organization-defined security safeguards.	The organization being inspected/assessed controls physical access to information system distribution and transmission lines defined in PE-4, CCI 2930 within organizational facilities using security safeguards defined in PE-4, CCI 2931.	The organization conducting the inspection/assessment inspects the information system distribution and transmission lines defined in PE-4, CCI 2930 to ensure the security safeguards defined in PE-4, CCI 2931 are in place.		X	X		Designer Non-Designer	3.3.6 Physical Security in MODERATE Impact...
PE-5	PE-5	CCI-000937	The organization controls physical access to information system output devices to prevent unauthorized individuals from obtaining the output.	The organization being inspected/assessed will identify, document, and execute any additional access controls required for output devices above and beyond physical access controls already in place for the facility IAW DoD 5200.08-R and DoD 5200.01-M (Volumes 1-4).	The organization conducting the inspection/assessment obtains and examines the list of additional access controls for output devices. Physical inspection is required to ensure these access controls are properly implemented.		X	X		Designer Non-Designer	3.3.6 Physical Security in MODERATE Impact...
RA-5(1)	RA-5(1)	CCI-001062	The organization employs vulnerability scanning tools that include the capability to readily update the information system vulnerabilities to be scanned.	The organization being inspected/assessed will employ scanning tools that maintain currency with industry standard information system vulnerabilities to ensure that scanning activities are conducted with the most up to date list of known vulnerabilities to include USCYBERCOM issued IAVMs. DoD has provided an enterprise scanning tool that fully meets this requirement. Organizations that choose not to use the enterprise scanning tool must identify which scanning tool they are using and ensure that it meets these requirements.	The organization conducting the inspection/assessment will: 1. If the inspected organization is using the DoD provided enterprise scanning tool, compliance with this control is complete. 2. Validate the identified tool in use by the inspected organization is able to maintain current up to date information system vulnerability data.	X	X		Enclave Designer	2.3 DATABASE AND WEB SERVER SOFTWARE FO... 3.11 VULNERABILITY SCANNING	
RA-5(5)	RA-5(5)	CCI-001067	The information system implements privileged access authorization to organization-identified information system components for selected organization-defined vulnerability scanning activities.	The organization being inspected/assessed configures the information system to implement privileged access authorization to all information systems and infrastructure components for selected vulnerability scanning activities defined in RA-5 (5), CCI 2906. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1067. DoD has defined the information system components as all information systems and infrastructure components.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to implement privileged access authorization to all information systems and infrastructure components for selected vulnerability scanning activities defined in RA-5 (5), CCI 2906. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1067. DoD has defined the information system components as all information systems and infrastructure components.	X	X		Enclave Designer	2.3 DATABASE AND WEB SERVER SOFTWARE FO... 3.11 VULNERABILITY SCANNING	
SC-7	SC-7(a)	CCI-001097	The information system monitors and controls communications at the external boundary of the system and at key internal boundaries within the system.	The organization being inspected/assessed documents and implements processes to monitor and control communications at the external boundary of the system and at key internal boundaries within the system. The organization must maintain an audit trail of monitoring activities.	The organization conducting the inspection/assessment obtains and examines the documented process as well as the audit trail of monitoring activities to ensure the organization being inspected/assessed monitors and controls communications at the external boundary of the system and at key internal boundaries within the system.	X	X	X	X	DoD-Defined Enclave Designer Impractical	3.3.6 Physical Security in MODERATE Impact... 3.7.2 Denial of Service Protection-TAI OP... 3.7.5 Process Isolation and Boundary Prot...
SC-7(5)	SC-7(5)	CCI-001109	The information system at managed interfaces denies network communications traffic by default and allows network communications traffic by exception (i.e., deny all, permit by exception).	The organization being inspected/assessed configures the information system to deny network communications traffic at managed interfaces by default and allows network communications traffic by exception (i.e., deny all, permit by exception). For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1109.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to deny network communications traffic at managed interfaces by default and allows network communications traffic by exception (i.e., deny all, permit by exception). For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1109.	X	X		Enclave Designer	1.9.2 Cybersecurity Interconnection Sched... 3.3.6 Physical Security in MODERATE Impact... 3.7.5 Process Isolation and Boundary Prot...	
SC-18	SC-18(a)	CCI-001160	The organization defines acceptable and unacceptable mobile code and mobile code technologies.	The organization being inspected/assessed defines and documents acceptable and unacceptable mobile code and mobile code technologies IAW the Protection Profile for Web Browsers and Application SRG. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must define IAW the STIG/SRG guidance that pertains to CCI 1160.	The organization conducting the inspection/assessment obtains and examines the documented acceptable and unacceptable mobile code and mobile code technologies to ensure the organization being inspected/assessed defines acceptable and unacceptable mobile code and mobile code technologies IAW the Protection Profile for Web Browsers and Application SRG. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has defined acceptable and unacceptable mobile code and mobile code technologies IAW the applicable STIGs and SRGs pertaining to CCI 1160.	X	X		Enclave Designer	3.7.3 Mobile Code In MODERATE Impact Syst...	

SC-18	SC-18(b)	CCI-001161	The organization establishes usage restrictions for acceptable mobile code and mobile code technologies.	The organization being inspected/assessed documents usage restrictions for acceptable mobile code and mobile code technologies IAW the Protection Profile for Web Browsers and Application SRG. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must establish IAW the STIG/SRG guidance that pertains to CCI 1161.	The organization conducting the inspection/assessment obtains and examines the documented usage restrictions to ensure the organization being inspected/assessed establishes usage restrictions for acceptable mobile code and mobile code technologies IAW the Protection Profile for Web Browsers and Application SRG. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has established usage restrictions IAW the applicable STIGs and SRGs pertaining to CCI 1161.		X	X				Enclave Designer	3.7.3 Mobile Code In MODERATE Impact Syst...
SC-18	SC-18(b)	CCI-001162	The organization establishes implementation guidance for acceptable mobile code and mobile code technologies.	The Protection Profile for Web Browsers and Application SRG meet the DoD requirement to establish implementation guidance for acceptable mobile code and mobile code technologies. DoD Components are automatically compliant with this CCI because they are covered by the Protection Profile for Web Browsers and Application SRG.	The Protection Profile for Web Browsers and Application SRG meet the DoD requirement to establish implementation guidance for acceptable mobile code and mobile code technologies. DoD Components are automatically compliant with this CCI because they are covered by the Protection Profile for Web Browsers and Application SRG.		X	X				Enclave Designer	3.7.3 Mobile Code In MODERATE Impact Syst...
SC-18	SC-18(c)	CCI-001163	The organizations authorizes the use of mobile code within the information system.	The organization being inspected/assessed documents mobile code which is authorized for use within the information system.	The organization conducting the inspection/assessment obtains and examines the documented list of mobile code which is authorized for use within the information system and examines the information system to ensure that all used mobile code is authorized.		X	X				Enclave Designer	3.7.3 Mobile Code In MODERATE Impact Syst...
SC-18	SC-18(c)	CCI-001164	The organization monitors the use of mobile code within the information system.	The organization being inspected/assessed documents and implements a process to monitor the use of mobile code within the information system.	The organization conducting the inspection/assessment obtains and examines the documented process as well as any artifacts applicable to monitoring of mobile code to ensure the organization being inspected/assessed monitors the use of mobile code within the information system.		X	X				Enclave Designer	3.7.3 Mobile Code In MODERATE Impact Syst...
SC-18	SC-18(c)	CCI-001165	The organization controls the use of mobile code within the information system.	The organization being inspected/assessed documents and implements a process to control the use of mobile code within the information system.	The organization conducting the inspection/assessment obtains and examines the documented process and examines the information system to ensure the organization being inspected/assessed controls the use of mobile code within the information system.		X	X				Enclave Designer	3.7.3 Mobile Code In MODERATE Impact Syst...
SC-18(1)	SC-18(1)	CCI-001166	The information system identifies organization-defined unacceptable mobile code.	The organization being inspected/assessed configures the information system to identify unacceptable mobile code defined in SC-18 (1), CCI 2458. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1166.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to identify unacceptable mobile code defined in SC-18 (1), CCI 2458. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1166.		X	X	X			Enclave Designer Non-Designer	3.7.3 Mobile Code In MODERATE Impact Syst...
SC-18(3)	SC-18(3)	CCI-001169	The information system prevents the download of organization-defined unacceptable mobile code.	The organization being inspected/assessed configures the information system to prevent the download of unacceptable mobile code defined in CCI 2459. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1169.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to prevent the download of unacceptable mobile code defined in CCI 2459. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1169.			X	X			Designer Non-Designer	3.7.3 Mobile Code In MODERATE Impact Syst...
SC-18(4)	SC-18(4)	CCI-001170	The information system prevents the automatic execution of mobile code in organization-defined software applications.	The organization being inspected/assessed configures the information system to prevent the automatic execution of unacceptable mobile code in software applications defined in CCI 1171. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1170.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to prevent the automatic execution of unacceptable mobile code in software applications defined in CCI 1171. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1170.			X				Designer	3.7.3 Mobile Code In MODERATE Impact Syst...
SC-28	SC-28	CCI-001199	The information system protects the confidentiality and/or integrity of organization-defined information at rest.	The organization being inspected/assessed configures the information system to protect the confidentiality and/or integrity of organization-defined information at rest. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1199.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to protect the confidentiality and/or integrity of organization-defined information at rest. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1199.		X	X		X		Enclave Designer Impractical	3.7.4 Protection of Information at Rest I...

SI-3	SI-3(c)(1)	CCI-001241	The organization configures malicious code protection mechanisms to perform periodic scans of the information system on an organization-defined frequency.	The organization being inspected/assessed configures malicious code protection mechanisms to perform periodic scans of the information system on every 7 days. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1241. DoD has defined the frequency as every 7 days.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures malicious code protection mechanisms to perform periodic scans of the information system on every 7 days. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1241. DoD has defined the frequency as every 7 days.		X	X	X		Enclave Designer Non-Designer	3.13.1 Malicious Code Protection
AC-4	AC-4	CCI-001368	The information system enforces approved authorizations for controlling the flow of information within the system based on organization-defined information flow control policies.	The organization being inspected/assessed configures the information system to enforce approved authorizations for controlling the flow of information within the system based on information flow control policies defined in AC-4, CCI 1548. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1368.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enforce approved authorizations for controlling the flow of information within the system based on information flow control policies defined in AC-4, CCI 1548. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1368.		X	X		X	Enclave Designer Impractical	3.2.1 Information Flow Enforcement in MOD...
AC-4	AC-4	CCI-001414	The information system enforces approved authorizations for controlling the flow of information between interconnected systems based on organization-defined information flow control policies.	The organization being inspected/assessed configures the information system to enforce approved authorizations for controlling the flow of information between interconnected systems based on information flow control policies defined in AC-4, CCI 1549. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1414.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enforce approved authorizations for controlling the flow of information between interconnected systems based on information flow control policies defined in AC-4, CCI 1549. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1414.		X	X		X	Enclave Designer Impractical	3.2.1 Information Flow Enforcement in MOD...
AC-18	AC-18(a)	CCI-001438	The organization establishes usage restrictions for wireless access.	The organization being inspected/assessed establishes and documents usage restrictions for wireless access.	The organization conducting the inspection/assessment obtains and examines documented usage restrictions to ensure the organization being inspected/assessed establishes usage restrictions for wireless access.			X	X		Designer Non-Designer	3.2.3 Wireless and Wired Broadcast Commun...
AC-18	AC-18(a)	CCI-001439	The organization establishes implementation guidance for wireless access.	The organization being inspected/assessed establishes and documents implementation guidance for wireless access.	The organization conducting the inspection/assessment obtains and examines the documented implementation guidance to ensure the organization being inspected/assessed establishes implementation guidance for wireless access.			X	X		Designer Non-Designer	3.2.3 Wireless and Wired Broadcast Commun...
AC-18	AC-18(b)	CCI-001441	The organization authorizes wireless access to the information system prior to allowing such connections.	The organization being inspected/assessed authorizes wireless access to the information system prior to allowing such connections. The organization must maintain an audit trail of authorizations.	The organization conducting the inspection/assessment obtains and examines the audit trail of authorizations to ensure the organization being inspected/assessed authorizes wireless access to the information system prior to allowing such connections.			X	X		Designer Non-Designer	3.2.3 Wireless and Wired Broadcast Commun...
AC-18(3)	AC-18(3)	CCI-001449	The organization disables, when not intended for use, wireless networking capabilities internally embedded within information system components prior to issuance and deployment.	The organization being inspected/assessed documents and implements a process to disable wireless networking capabilities internally embedded within information system components prior to issuance and deployment when not intended for use.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed disables, when not intended for use, wireless networking capabilities internally embedded within information system components prior to issuance and deployment. The organization conducting the inspection/assessment obtains and examines a sampling of information systems to ensure that any internally embedded wireless networking capabilities are disabled unless a documented need exists.			X			Designer	---
AU-5	AU-5(b)	CCI-001490	The organization defines actions to be taken by the information system upon audit failure (e.g., shut down information system, overwrite oldest audit records, stop generating audit records).	The organization being inspected/assessed will define and document actions to be taken by the information system upon audit failure. The organization shall consider trade-offs between the needs for system availability and audit integrity when defining the actions. Unless availability is an overriding concern, the default action should be to shut down the information system. DoD has determined that the actions are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented actions to ensure the organization being inspected/assessed has defined the actions to be taken by the information system upon audit failure. DoD has determined that the actions are not appropriate to define at the Enterprise level.		X	X	X	X	Enclave Designer Non-Designer Impractical	3.5.5 Response to Audit Processing Failur...
AC-4	AC-4	CCI-001548	The organization defines the information flow control policies for controlling the flow of information within the system.	The organization being inspected/assessed defines and documents the information flow control policies for controlling the flow of information within the system. DoD has determined the information flow control policies are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented information flow control policies to ensure the organization being inspected/assessed defines the information flow control policies for controlling the flow of information within the system. DoD has determined the information flow control policies are not appropriate to define at the Enterprise level.		X	X	X	X	Enclave Designer Non-Designer Impractical	3.2.1 Information Flow Enforcement in MOD...

AC-4	AC-4	CCI-001549	The organization defines the information flow control policies for controlling the flow of information between interconnected systems.	The organization being inspected/assessed defines and documents the information flow control policies for controlling the flow of information between interconnected systems. DoD has determined the information flow control policies are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented information flow control policies to ensure the organization being inspected/assessed defines the information flow control policies for controlling the flow of information between interconnected systems. DoD has determined the information flow control policies are not appropriate to define at the Enterprise level.		X	X	X	X	Enclave Designer Non-Designer Impractical	3.2.1 Information Flow Enforcement in MOD...
AC-4	AC-4	CCI-001550	The organization defines approved authorizations for controlling the flow of information within the system.	The organization being inspected/assessed defines and documents approved authorizations for controlling the flow of information within the system.	The organization conducting the inspection/assessment obtains and examines the documented approved authorizations to ensure the organization being inspected/assessed defines approved authorizations for controlling the flow of information within the system.		X	X	X	X	Enclave Designer Non-Designer Impractical	3.2.1 Information Flow Enforcement in MOD...
AC-4	AC-4	CCI-001551	The organization defines approved authorizations for controlling the flow of information between interconnected systems.	The organization being inspected/assessed defines and documents approved authorizations for controlling the flow of information between interconnected systems.	The organization conducting the inspection/assessment obtains and examines the documented approved authorizations to ensure the organization being inspected/assessed defines approved authorizations for controlling the flow of information between interconnected systems.		X	X	X	X	Enclave Designer Non-Designer Impractical	3.2.1 Information Flow Enforcement in MOD...
CM-6	CM-6(a)	CCI-001588	The organization-defined security configuration checklists reflect the most restrictive mode consistent with operational requirements.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for ensuring security configuration checklists reflect the most restrictive mode consistent with operational requirements. DoD Components are automatically compliant with this CCI because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.).	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for ensuring security configuration checklists reflect the most restrictive mode consistent with operational requirements. DoD Components are automatically compliant with this CCI because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.).	X		X	X	X	DoD-Defined Designer Non-Designer Impractical	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
RA-5(5)	RA-5(5)	CCI-001645	The organization identifies the information system components to which privileged access is authorized for selected organization-defined vulnerability scanning activities.	DoD has defined the information system components as all information systems and infrastructure components.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the information system components as all information systems and infrastructure components.	X	X	X		X	DoD-Defined Enclave Designer Impractical	2.3 DATABASE AND WEB SERVER SOFTWARE FO... 3.11 VULNERABILITY SCANNING
SC-18(1)	SC-18(1)	CCI-001662	The information system takes organization-defined corrective action when organization-defined unacceptable mobile code is identified.	The organization being inspected/assessed configures the information system to take corrective actions defined in SC-18 (1), CCI 2457 when unacceptable mobile code defined in SC-18 (1), CCI 2458 is identified. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1662.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to take corrective actions defined in SC-18 (1), CCI 2457 when unacceptable mobile code defined in SC-18 (1), CCI 2458 is identified. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1662.		X	X	X		Enclave Designer Non-Designer	3.7.3 Mobile Code in MODERATE Impact Syst...
SC-18(3)	SC-18(3)	CCI-001695	The information system prevents the execution of organization-defined unacceptable mobile code.	The organization being inspected/assessed configures the information system to prevent the execution of unacceptable mobile code defined in CCI 2459. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1695.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to prevent the execution of unacceptable mobile code defined in CCI 2459. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1695.			X	X		Designer Non-Designer	3.7.3 Mobile Code in MODERATE Impact Syst...
CM-5(3)	CM-5(3)	CCI-001749	The information system prevents the installation of organization-defined software components without verification the software component has been digitally signed using a certificate that is recognized and approved by the organization.	The organization being inspected/assessed documents and implements a process to prevent the installation of software onto any software components when the vendor provides digitally signed products without verification that software has been digitally signed using a certificate and approved by the organization. DoD has defined the software components as any software components when the vendor provides digitally signed products.	The organization conducting the inspection/assessment obtains and examines the documented process for preventing the installation of software onto any software components when the vendor provides digitally signed products without verification that software has been digitally signed using a certificate and approved by the organization. The organization conducting the inspection/assessment reviews software on a sampling of the defined components to ensure that only software digitally signed by a defined CA is installed. DoD has defined the software components as any software components when the vendor provides digitally signed products.			X				---
CM-6	CM-6(c)	CCI-001755	The organization defines the information system components for which any deviation from the established configuration settings are to be identified, documented and approved.	DoD has defined the information system components as all configurable information system components.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the information system components as all configurable information system components.	X		X	X	X	DoD-Defined Designer Non-Designer Impractical	3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
CM-7(1)	CM-7(1)(b)	CCI-001761	The organization defines the functions, ports, protocols and services within the information system that are to be disabled when deemed unnecessary and/or nonsecure.	The organization being inspected/assessed must define and document in the system security plan, the functions, ports, protocols and services within the information system that are to be disabled when deemed unnecessary. DoD has determined that it is not appropriate to define unnecessary functions, ports, protocols and service at the Enterprise level. Nonsecure functions, ports, protocols and services are defined in DoDI 8551.01.	The organization conducting the inspection/assessment obtains and examines the system security plan to ensure the organization being inspected/assessed defines the functions, ports, protocols and services within the information system that are to be disabled when deemed unnecessary. DoD has determined that it is not appropriate to define unnecessary functions, ports, protocols and service at the Enterprise level. Nonsecure functions, ports, protocols and services are defined in DoDI 8551.01.			X			Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...

CM-7(1)	CM-7(1)(b)	CCI-001762	The organization disables organization-defined functions, ports, protocols, and services within the information system deemed to be unnecessary and/or nonsecure.	The organization being inspected/assessed must disable functions, ports, protocols, and services within the information system deemed to be unnecessary and/or nonsecure as defined in CM-7 (1), CCI 1761.	The organization conducting the inspection/assessment inspects the information system to ensure the organization being inspected/assessed disables functions, ports, protocols, and services within the information system deemed to be unnecessary and/or nonsecure as defined in CM-7 (1), CCI 1761.			X		X	Designer Impractical	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
AU-5(1)	AU-5(1)	CCI-001855	The information system provides a warning to organization-defined personnel, roles, and/or locations within organization-defined time period when allocated audit record storage volume reaches organization-defined percentage of repository maximum audit record storage capacity.	The organization being inspected/assessed configures the information system to immediately provide a warning to personnel, roles, and/or locations defined in AU-5 (1), CCI 1852 when allocated audit record storage volume reaches 75 percent of repository maximum audit record storage capacity. DoD has defined the time period as immediate. DoD has defined the percentage as 75 percent. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1855.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed has configured the information system to immediately provide a warning to personnel, roles, and/or locations defined in AU-5 (1), CCI 1852 when allocated audit record storage volume reaches 75 percent of repository maximum audit record storage capacity. DoD has defined the time period as immediate. DoD has defined the percentage as 75 percent. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1855.			X			Designer	3.5.4.1 Audit Log Storage Notification In M...
IA-3	IA-3	CCI-001958	The information system authenticates an organization defined list of specific and/or types of devices before establishing a local, remote, or network connection.	The organization being inspected/assessed configures the network infrastructure to authenticate all mobile devices and network connected endpoint devices (including but not limited to: workstations, printers, servers (outside a datacenter), VoIP Phones, VTC CODECs) before establishing a local, remote, network connection. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1958. DoD has defined the value as all mobile devices and network connected endpoint devices (including but not limited to: workstations, printers, servers (outside a datacenter), VoIP Phones, VTC CODECs).	The organization conducting the inspection/assessment examine a sampling of the network infrastructure device configurations to ensure devices connecting to the infrastructure are uniquely authenticated. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1958.		X	X		X	Enclave Designer Impractical	1.9.4 Control System Inventory Report 3.2.7 Device Identification and Authentic...
CA-9	CA-9(a)	CCI-002102	The organization defines the information system components or classes of components that are authorized internal connections to the information system.	The organization being inspected/assessed defines and documents the information system components or classes of components that are authorized internal connections to the information system. DoD has determined the information system components are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented information system components to ensure the organization being inspected/assessed defines the information system components or classes of components that are authorized internal connections to the information system. DoD has determined the information system components are not appropriate to define at the Enterprise level.			X			Designer	1.9.3 Network Communication Report
CA-9	CA-9(b)	CCI-002103	The organization documents, for each internal connection, the interface characteristics.	The organization being inspected/assessed documents, for each internal connection, the interface characteristics.	The organization conducting the inspection/assessment obtains and examines the documented interface characteristics as well as the network topology to ensure the organization being inspected/assessed documents, for each internal connection, the interface characteristics.			X			Designer	1.9.3 Network Communication Report
CA-9	CA-9(b)	CCI-002104	The organization documents, for each internal connection, the security requirements.	The organization being inspected/assessed documents, for each internal connection, the security requirements.	The organization conducting the inspection/assessment obtains and examines the documented security requirements as well as the network topology to ensure the organization being inspected/assessed documents, for each internal connection, the security requirements.			X			Designer	1.9.3 Network Communication Report
CA-9	CA-9(b)	CCI-002105	The organization documents, for each internal connection, the nature of the information communicated.	The organization being inspected/assessed documents, for each internal connection, the nature of the information communicated.	The organization conducting the inspection/assessment obtains and examines the documented nature of information communication as well as the network topology to ensure the organization being inspected/assessed documents, for each internal connection, the nature of the information communicated.			X			Designer	1.9.3 Network Communication Report
AC-18	AC-18(a)	CCI-002323	The organization establishes configuration/connection requirements for wireless access.	The organization being inspected/assessed establishes and documents configuration/connection requirements for wireless access.	The organization conducting the inspection/assessment obtains and examines the documented configuration/connection requirements to ensure the organization being inspected/assessed establishes configuration/connection requirements for wireless access.			X	X		Designer Non-Designer	3.2.3 Wireless and Wired Broadcast Commun...
SC-7(9)	SC-7(9)(a)	CCI-002398	The information system detects outgoing communications traffic posing a threat to external information systems.	The organization being inspected/assessed configures the information system to detect outgoing communications traffic posing a threat to external information systems. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2398.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to detect outgoing communications traffic posing a threat to external information systems. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2398.		X	X	X		Enclave Designer Non-Designer	1.9.2 Cybersecurity Interconnection Sched... 3.7.5 Process Isolation and Boundary Prot...

SC-7(9)	SC-7(9)(a)	CCI-002399	The information system denies outgoing communications traffic posing a threat to external information systems.	The organization being inspected/assessed configures the information system to deny outgoing communications traffic posing a threat to external information systems. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2399.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to deny outgoing communications traffic posing a threat to external information systems. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2399.		X	X	X		Enclave Designer Non-Designer	1.9.2 Cybersecurity Interconnection Sched... 3.7.5 Process Isolation and Boundary Prot...
SC-7(11)	SC-7(11)	CCI-002401	The organization defines the authorized sources from which the information system will allow incoming communications.	The organization being inspected/assessed defines and documents the authorized sources from which the information system will allow incoming communications. DoD has determined the authorized sources are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented authorized sources to ensure the organization being inspected/assessed defines the authorized sources from which the information system will allow incoming communications. DoD has determined the authorized sources are not appropriate to define at the Enterprise level.		X	X	X		Enclave Designer Non-Designer	1.9.2 Cybersecurity Interconnection Sched...
SC-7(11)	SC-7(11)	CCI-002402	The organization defines the authorized destinations for routing inbound communications.	The organization being inspected/assessed defines and documents the authorized destinations for routing inbound communications. DoD has determined the authorized destinations are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented authorized destinations to ensure the organization being inspected/assessed defines the authorized destinations for routing inbound communications. DoD has determined the authorized destinations are not appropriate to define at the Enterprise level.		X	X	X		Enclave Designer Non-Designer	1.9.2 Cybersecurity Interconnection Sched...
SC-7(11)	SC-7(11)	CCI-002403	The information system only allows incoming communications from organization-defined authorized sources routed to organization-defined authorized destinations.	The organization being inspected/assessed configures the information system to allow incoming communications from authorized sources defined in SC-7 (11), CCI 2401 routed to authorized destinations defined in SC-7 (11), CCI 2402. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2403.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to allow incoming communications from authorized sources defined in SC-7 (11), CCI 2401 routed to authorized destinations defined in SC-7 (11), CCI 2402. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2403.		X	X	X		Enclave Designer Non-Designer	1.9.2 Cybersecurity Interconnection Sched... 3.7.5 Process Isolation and Boundary Prot...
SC-8	SC-8	CCI-002418	The information system protects the confidentiality and/or integrity of transmitted information.	The organization being inspected/assessed configures the information system to protect the confidentiality and/or integrity of transmitted information. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2418.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to protect the confidentiality and/or integrity of transmitted information. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2418.			X			Designer	3.2.6 Cryptographic Protection 3.3.6 Physical Security in MODERATE Impact...
SC-8(1)	SC-8(1)	CCI-002419	The organization defines the alternative physical safeguards to be employed when cryptographic mechanisms are not implemented to protect information during transmission.	DoD has defined the alternative physical safeguards as Protected Distribution System (PDS).	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the alternative physical safeguards as Protected Distribution System (PDS).	X		X			DoD-Defined Designer	3.3.6 Physical Security in MODERATE Impact...
SC-8(1)	SC-8(1)	CCI-002421	The information system implements cryptographic mechanisms to prevent unauthorized disclosure of information and/or detect changes to information during transmission unless otherwise protected by organization-defined alternative physical safeguards.	The organization being inspected/assessed configures the information system to implement cryptographic mechanisms to prevent unauthorized disclosure of information and detect changes to information during transmission unless otherwise protected by Protected Distribution System (PDS). For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2421. DoD has defined the selection as both prevention of unauthorized disclosure and detection of changes to information. DoD has defined the alternative physical safeguards as Protected Distribution System (PDS).	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to implement cryptographic mechanisms to prevent unauthorized disclosure of information and detect changes to information during transmission unless otherwise protected by Protected Distribution System (PDS). For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2421. DoD has defined the alternative physical safeguards as Protected Distribution System (PDS).			X			Designer	3.3.6 Physical Security in MODERATE Impact...
SC-18(1)	SC-18(1)	CCI-002457	The organization defines the corrective actions to be taken when organization-defined unacceptable mobile code is identified.	DoD has defined the corrective actions to be taken when organization-defined unacceptable mobile code is identified as the corrective actions defined in the Protection Profile for Web Browsers and Application SRG.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the corrective actions to be taken when organization-defined unacceptable mobile code is identified as the corrective actions defined in the Protection Profile for Web Browsers and Application SRG.		X	X	X		Enclave Designer Non-Designer	3.7.3 Mobile Code In MODERATE Impact Syst...

SC-18(1)	SC-18(1)	CCI-002458	The organization defines what constitutes unacceptable mobile code for its information systems.	The organization being inspected/assessed defines and documents unacceptable mobile code IAW the Protection Profile for Web Browsers and Application SRG. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must define IAW the STIG/SRG guidance that pertains to CCI 2458. DoD has determined the unacceptable mobile code is not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented acceptable and unacceptable mobile code and mobile code technologies to ensure the organization being inspected/assessed defines unacceptable mobile code IAW the Protection Profile for Web Browsers and Application SRG. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has defined unacceptable mobile code IAW the applicable STIGs and SRGs pertaining to CCI 2458. DoD has determined the unacceptable mobile code is not appropriate to define at the Enterprise level.	X	X	X		Enclave Designer Non-Designer	3.7.3 Mobile Code In MODERATE Impact Syst...
SC-23(5)	SC-23(5)	CCI-002469	The organization defines the certificate authorities the information system will allow to be used on the information system.	DoD has defined the certificate authorities as DoD PKI established certificate authorities.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the certificate authorities as DoD PKI established certificate authorities.	X		X		DoD-Defined Non-Designer	3.7.3 Mobile Code In MODERATE Impact Syst...
SC-28	SC-28	CCI-002472	The organization defines the information at rest that is to be protected by the information system.	The organization being inspected/assessed defines and documents the information at rest that is to be protected by the information system which must include, at a minimum, PII and classified information. DoD has determined the information at rest is not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented information at rest to ensure the organization being inspected/assessed defines and documents the information at rest that is to be protected by the information system which must include, at a minimum, PII and classified information. DoD has determined the information at rest is not appropriate to define at the Enterprise level.		X	X	X	Designer Non-Designer Impractical	3.7.4 Protection of Information at Rest I...
SC-28(1)	SC-28(1)	CCI-002475	The information system implements cryptographic mechanisms to prevent unauthorized modification of organization-defined information system components.	The organization being inspected/assessed configures the information system to implement cryptographic mechanisms to prevent unauthorized modification of information at rest defined in SC-28 (1), CCI 2473 on any information system components storing data defined in SC-28 (1), 2473. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2475. DoD has defined the information system components as any information system components storing data defined in SC-28 (1), 2473.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to implement cryptographic mechanisms to prevent unauthorized modification of information at rest defined in SC-28 (1), CCI 2473 on any information system components storing data defined in SC-28 (1), 2473. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2475. DoD has defined the information system components as any information system components storing data defined in SC-28 (1), 2473.	X		X	X	DoD-Defined Designer Impractical	3.7.4 Protection of Information at Rest I...
SC-28(1)	SC-28(1)	CCI-002476	The information system implements cryptographic mechanisms to prevent unauthorized disclosure of organization-defined information at rest on organization-defined information system components.	The organization being inspected/assessed configures the information system to implement cryptographic mechanisms to prevent unauthorized disclosure of information at rest defined in SC-28 (1), CCI 2473 on any information system components storing data defined in SC-28 (1), 2473. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2476. DoD has defined the information system components as any information system components storing data defined in SC-28 (1), 2473.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to implement cryptographic mechanisms to prevent unauthorized disclosure of information at rest defined in SC-28 (1), CCI 2473 on any information system components storing data defined in SC-28 (1), 2473. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2476. DoD has defined the information system components as any information system components storing data defined in SC-28 (1), 2473.	X		X	X	DoD-Defined Designer Impractical	3.7.4 Protection of Information at Rest I...
SC-41	SC-41	CCI-002544	The organization defines the information systems or information system components on which organization-defined connection ports or input/output devices are to be physically disabled or removed.	The organization being inspected/assessed defines and documents the information systems or information system components on which organization-defined connection ports or input/output devices are to be physically disabled or removed. DoD has determined the information systems or information system components are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented information systems or information system components to ensure the organization being inspected/assessed defines the information systems or information system components on which organization-defined connection ports or input/output devices are to be physically disabled or removed. DoD has determined the information systems or information system components are not appropriate to define at the Enterprise level.		X	X	X	Enclave Designer Non-Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
SC-41	SC-41	CCI-002545	The organization defines the connection ports or input/output devices that are to be physically disabled or removed from organization-defined information systems or information system components.	The organization being inspected/assessed defines and documents the connection ports or input/output devices that are to be physically disabled or removed from organization-defined information systems or information system components. DoD has determined the connection ports or input/output devices are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented connection ports or input/output devices to ensure the organization being inspected/assessed defines the connection ports or input/output devices that are to be physically disabled or removed from organization-defined information systems or information system components. DoD has determined the connection ports or input/output devices are not appropriate to define at the Enterprise level.		X	X	X	Enclave Designer Non-Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
SC-41	SC-41	CCI-002546	The organization physically disables or removes organization-defined connection ports or input/output devices on organization-defined information systems or information system components.	The organization being inspected/assessed physically disables or removes connection ports or input/output devices defined in SC-41, CCI 2545 on information systems or information system components defined in SC-41, CCI 2544.	The organization conducting the inspection/assessment obtains a sampling of devices to ensure the organization being inspected/assessed physically disables or removes connection ports or input/output devices defined in SC-41, CCI 2545 on information systems or information system components defined in SC-41, CCI 2544.			X	X	Designer Impractical	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...

SI-3	SI-3(c)(1)	CCI-002623	The organization defines the frequency for performing periodic scans of the information system for malicious code.	DoD has defined the frequency as every 7 days.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as every 7 days.	X		X		X	DoD-Defined Designer Impractical	3.13.1 Malicious Code Protection
SI-7	SI-7	CCI-002704	The organization employs integrity verification tools to detect unauthorized changes to organization-defined software, firmware, and information.	The organization being inspected/assessed designs the information system to employ integrity verification tools to detect unauthorized changes to software, firmware, and information defined in SI-7, CCI 2703.	The organization conducting the inspection/assessment obtains and examines the hardware/software lists and any other documentation applicable to integrity verification tools to ensure the organization being inspected/assessed employs integrity verification tools to detect unauthorized changes to software, firmware, and information defined in SI-7, CCI 2703.		X		X		Enclave Non-Designer	---
SI-7(9)	SI-7(9)	CCI-002726	The information system verifies the integrity of the boot process of organization-defined devices.	The organization being inspected/assessed configures the information system to verify the integrity of the boot process of all devices capable of verification of the boot process. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2726. DoD has defined the devices as all devices capable of verification of the boot process.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to verify the integrity of the boot process of all devices capable of verification of the boot process. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2726. DoD has defined the devices as all devices capable of verification of the boot process.							---
SI-10(3)	SI-10(3)	CCI-002754	The information system behaves in a predictable and documented manner that reflects organizational and system objectives when invalid inputs are received.	The organization being inspected/assessed documents proper behavior that reflects organizational and system objectives for when invalid inputs are received. The organization being inspected/assessed configures the information system to behave in the documented manner when invalid inputs are received. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2754.	The organization conducting the inspection/assessment obtains and examines the documented behavior to ensure the organization being inspected/assessed documents proper behavior that reflects organizational and system objectives for when invalid inputs are received. The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to behave in the documented manner when invalid inputs are received. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2754.			X		X	Designer Impractical	3.8 SAFE MODE AND FAIL SAFE OPERATION
SI-17	SI-17	CCI-002773	The organization defines the fail-safe procedures to be implemented by the information system when organization-defined failure conditions occur.	The organization being inspected/assessed defines and documents the fail-safe procedures to be implemented by the information system when organization-defined failure conditions occur. DoD has determined the fail-safe procedures are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented fail-safe procedures to ensure the organization being inspected/assessed defines the fail-safe procedures to be implemented by the information system when organization-defined failure conditions occur. DoD has determined the fail-safe procedures are not appropriate to define at the Enterprise level.			X			Designer	1.9.4 Control System Inventory Report 3.8 SAFE MODE AND FAIL SAFE OPERATION
SI-17	SI-17	CCI-002774	The organization defines the failure conditions which, when they occur, will result in the information system implementing organization-defined fail-safe procedures.	The organization being inspected/assessed defines and documents the failure conditions which, when they occur, will result in the information system implementing organization-defined fail-safe procedures. DoD has determined the failure conditions are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented failure conditions to ensure the organization being inspected/assessed defines the failure conditions which, when they occur, will result in the information system implementing organization-defined fail-safe procedures. DoD has determined the failure conditions are not appropriate to define at the Enterprise level.			X			Designer	1.9.4 Control System Inventory Report 3.8 SAFE MODE AND FAIL SAFE OPERATION
SI-17	SI-17	CCI-002775	The information system implements organization-defined fail-safe procedures when organization-defined failure conditions occur.	The organization being inspected/assessed configures the information system to implement fail-safe procedures defined in SI-17, CCI 2773 when failure conditions defined in SI-17, CCI 2774 occur. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2775.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to implement fail-safe procedures defined in SI-17, CCI 2773 when failure conditions defined in SI-17, CCI 2774 occur. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2775.			X			Designer	1.9.4 Control System Inventory Report 3.8 SAFE MODE AND FAIL SAFE OPERATION
CP-12	CP-12	CCI-002855	The information system, when organization-defined conditions are detected, enters a safe mode of operation with organization-defined restrictions of safe mode of operation.	The organization being inspected/assessed configures the information system to enter a safe mode of operation with restrictions of safe mode of operation defined in CP-12, CCI 2857 when conditions defined in CP-12, CCI 2856 are detected. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2855.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enter a safe mode of operation with restrictions of safe mode of operation defined in CP-12, CCI 2857 when conditions defined in CP-12, CCI 2856 are detected. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2855.			X			Designer	3.8 SAFE MODE AND FAIL SAFE OPERATION

CP-12	CP-12	CCI-002856	The organization defines the conditions, that when detected, the information system enters a safe mode of operation with organization-defined restrictions of safe mode of operation.	The organization being inspected/assessed defines and documents the conditions, that when detected, the information system enters a safe mode of operation with organization-defined restrictions of safe mode of operation. DoD has determined the conditions are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented conditions to ensure the organization being inspected/assessed defines the conditions, that when detected, the information system enters a safe mode of operation with organization-defined restrictions of safe mode of operation. DoD has determined the conditions are not appropriate to define at the Enterprise level.			X				Designer	3.8 SAFE MODE AND FAIL SAFE OPERATION
CP-12	CP-12	CCI-002857	The organization defines the restrictions of safe mode of operation that the information system will enter when organization-defined conditions are detected.	The organization being inspected/assessed defines and documents the restrictions of safe mode of operation that the information system will enter when organization-defined conditions are detected. DoD has determined the restrictions on safe mode of operation are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented restrictions to ensure the organization being inspected/assessed defines the restrictions of safe mode of operation that the information system will enter when organization-defined conditions are detected. DoD has determined the restrictions on safe mode of operation are not appropriate to define at the Enterprise level.			X				Designer	3.8 SAFE MODE AND FAIL SAFE OPERATION
RA-5(5)	RA-5(5)	CCI-002906	The organization defines the vulnerability scanning activities in which the information system implements privileged access authorization to organization-identified information system components.	The organization being inspected/assessed defines and documents the vulnerability scanning activities in which the information system implements privileged access authorization to organization-identified information system components. DoD has determined the vulnerability scanning activities are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented vulnerability scanning activities to ensure the organization being inspected/assessed defines the vulnerability scanning activities in which the information system implements privileged access authorization to organization-identified information system components. DoD has determined the vulnerability scanning activities are not appropriate to define at the Enterprise level.		X	X				Enclave Designer	2.3 DATABASE AND WEB SERVER SOFTWARE FO... 3.11 VULNERABILITY SCANNING
PE-3(1)	PE-3(1)	CCI-002926	The organization defines the physical spaces containing one or more components of the information system that require physical access authorizations and controls at the facility.	The organization being inspected/assessed defines and documents the physical spaces containing one or more components of the information system that require physical access authorizations and controls at the facility. DoD has determined the physical spaces are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented physical spaces to ensure the organization being inspected/assessed defines the physical spaces containing one or more components of the information system that require physical access authorizations and controls at the facility. DoD has determined the physical spaces are not appropriate to define at the Enterprise level.			X	X			Designer Non-Designer	3.3.6 Physical Security in MODERATE Impact...
PE-4	PE-4	CCI-002930	The organization defines information system distribution and transmission lines within organizational facilities to control physical access using organization-defined security safeguards.	The organization being inspected/assessed defines and documents information system distribution and transmission lines within organizational facilities to control physical access using organization-defined security safeguards. If transmission lines carry classified information, a protected distribution system (PDS) must be used to transmit unencrypted classified information through an area of lesser classification or control. For additional information, see NSTISSI No. 7003. DoD has determined the information system distribution and transmission lines are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented information system distribution and transmission lines to ensure the organization being inspected/assessed defines information system distribution and transmission lines within organizational facilities to control physical access using organization-defined security safeguards. DoD has determined the information system distribution and transmission lines are not appropriate to define at the Enterprise level.			X	X			Designer Non-Designer	3.3.6 Physical Security in MODERATE Impact...
PE-4	PE-4	CCI-002931	The organization defines security safeguards to control physical access to organization-defined information system distribution and transmission lines within organizational facilities.	The organization being inspected/assessed defines and documents security safeguards to control physical access to organization-defined information system distribution and transmission lines within organizational facilities. DoD has determined the security safeguards are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented security safeguards to ensure the organization being inspected/assessed defines security safeguards to control physical access to organization-defined information system distribution and transmission lines within organizational facilities. DoD has determined the security safeguards are not appropriate to define at the Enterprise level.			X	X			Designer Non-Designer	3.3.6 Physical Security in MODERATE Impact...
PL-2	PL-2(a)(2)	CCI-003051	The organization's security plan for the information system explicitly defines the authorization boundary for the system.	The organization being inspected/assessed explicitly defines within the security plan the authorization boundary for the system.	The organization conducting the inspection/assessment obtains and examines the security plan to ensure the organization being inspected/assessed explicitly defines within the security plan the authorization boundary for the system.		X	X	X			Enclave Designer Non-Designer	1.9.6 Cybersecurity Riser Diagram
PL-2	PL-2(a)(4)	CCI-003053	The organization's security plan for the information system provides the security categorization of the information system including supporting rationale.	The organization being inspected/assessed defines within the security plan the security categorization of the information system including supporting rationale.	The organization conducting the inspection/assessment obtains and examines the security plan to ensure the organization being inspected/assessed defines within the security plan the security categorization of the information system including supporting rationale.			X	X			Designer Non-Designer	1.9.6 Cybersecurity Riser Diagram
PL-7	PL-7(a)	CCI-003071	The organization develops a security Concept of Operations (CONOPS) for the information system containing at a minimum, how the organization intends to operate the system from the perspective of information security.	The organization being inspected/assessed develops and documents a security Concept of Operations (CONOPS) for the information system containing at a minimum, how the organization intends to operate the system from the perspective of information security.	The organization conducting the inspection/assessment obtains and examines the security CONOPS to ensure the organization being inspected/assessed develops a security CONOPS for the information system containing at a minimum, how the organization intends to operate the system from the perspective of information security.			X	X			Designer Non-Designer	1.9 CYBERSECURITY DOCUMENTATION
PL-8	PL-8(a)	CCI-003072	The organization develops an information security architecture for the information system.	The organization being inspected/assessed develops and documents an information security architecture for the information system.	The organization conducting the inspection/assessment obtains and examines the documented information security architecture to ensure the organization being inspected/assessed develops an information security architecture for the information system.			X	X			Designer Non-Designer	1.9.2 Cybersecurity Interconnection Sched... 1.9.3 Network Communication Report 1.9.6 Cybersecurity Riser Diagram
PL-8	PL-8(a)(1)	CCI-003073	The organization's information security architecture for the information system describes the overall philosophy, requirements, and approach to be taken with regard to protecting the confidentiality, integrity, and availability of organizational information.	The organization being inspected/assessed describes within the information security architecture for the information system, the overall philosophy, requirements, and approach to be taken with regard to protecting the confidentiality, integrity, and availability of organizational information.	The organization conducting the inspection/assessment obtains and examines the information security architecture to ensure the organization being inspected/assessed describes within the information security architecture for the information system, the overall philosophy, requirements, and approach to be taken with regard to protecting the confidentiality, integrity, and availability of organizational information.			X	X			Designer Non-Designer	1.9.2 Cybersecurity Interconnection Sched... 1.9.3 Network Communication Report 1.9.6 Cybersecurity Riser Diagram

PL-8	PL-8(a)(3)	CCI-003075	The organization's information security architecture for the information system describes any information security assumptions about, and dependencies on, external services.	The organization being inspected/assessed describes within the information security architecture for the information system, any information security assumptions about, and dependencies on, external services.	The organization conducting the inspection/assessment obtains and examines the information security architecture to ensure the organization being inspected/assessed describes within the information security architecture for the information system, any information security assumptions about, and dependencies on, external services.			X	X			Designer Non-Designer	1.9.2 Cybersecurity Interconnection Sched... 1.9.3 Network Communication Report 1.9.6 Cybersecurity Riser Diagram
SA-4(10)	SA-4(10)	CCI-003116	The organization employs only information technology products on the FIPS 201-approved products list for Personal Identity Verification (PIV) capability implemented within organizational information systems.	The organization being inspected/assessed employs DoD approved PKI tokens for identity verification.	The organization conducting the inspection/assessment examines the information system to ensure DoD approved PKI tokens are implemented for identity verification.		X	X		X		Enclave Designer Impractical	3.12 FIPS 201-2 REQUIREMENT
SA-5	SA-5(a)(1)	CCI-003124	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure configuration of the system, component, or service.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure configuration of the system, component, or service.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide administrator documentation for the information system, system component or information system service that describe secure configuration of the system, component, or service.			X	X			Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.2.1 HVAC Control System Devices FULLY S... 1.9.8.2.2 All Other HVAC Control System Devic... 1.9.8.3.1 Lighting Control System Devices FUL... 1.9.8.3.2 All Other Lighting Control System D... 1.9.8.5 Default Requirements for Control Sy...
SA-5	SA-5(a)(1)	CCI-003125	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure installation of the system, component, or service.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure installation of the system, component, or service.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide administrator documentation for the information system, system component or information system service that describe secure installation of the system, component, or service.			X	X			Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.5 Default Requirements for Control Sy...
SA-5	SA-5(a)(1)	CCI-003126	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure operation of the system, component, or service.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure operation of the system, component, or service.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide administrator documentation for the information system, system component or information system service that describe secure operation of the system, component, or service.			X	X			Designer Non-Designer	1.9.8 Control System Cybersecurity Docume...
SA-5	SA-5(a)(2)	CCI-003127	The organization obtains administrator documentation for the information system, system component, or information system services that describes effective use and maintenance of security functions/mechanisms.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe effective use and maintenance of security functions/mechanisms.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide administrator documentation for the information system, system component or information system service that describe effective use and maintenance of security functions/mechanisms.			X	X			Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.1 Software Applications 1.9.8.2.1 HVAC Control System Devices FULLY S... 1.9.8.2.2 All Other HVAC Control System Devic... 1.9.8.3.1 Lighting Control System Devices FUL... 1.9.8.3.2 All Other Lighting Control System D... 1.9.8.5 Default Requirements for Control Sy...
SA-5	SA-5(a)(3)	CCI-003128	The organization obtains administrator documentation for the information system, system component, or information system services that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide administrator documentation for the information system, system component or information system service that describe known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions.			X	X			Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.1 Software Applications 1.9.8.2.1 HVAC Control System Devices FULLY S... 1.9.8.3.1 Lighting Control System Devices FUL... 1.9.8.5 Default Requirements for Control Sy...
SA-5	SA-5(b)(1)	CCI-003129	The organization obtains user documentation for the information system, system component, or information system service that describes user-accessible security functions/mechanisms and how to effectively use those security functions/mechanisms.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide user documentation for the information system, system component or information system service that describes user-accessible security functions/mechanisms and how to effectively use those security functions/mechanisms.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide user documentation for the information system, system component or information system service that describes user-accessible security functions/mechanisms and how to effectively use those security functions/mechanisms.			X	X			Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.1 Software Applications 1.9.8.2.1 HVAC Control System Devices FULLY S... 1.9.8.3.1 Lighting Control System Devices FUL... 1.9.8.5 Default Requirements for Control Sy...
SA-5	SA-5(b)(2)	CCI-003130	The organization obtains user documentation for the information system, system component or information system service that describes methods for user interaction which enables individuals to use the system, component, or service in a more secure manner.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide user documentation for the information system, system component or information system service that describes methods for user interaction which enables individuals to use the system, component, or service in a more secure manner.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide user documentation for the information system, system component or information system service that describes methods for user interaction which enables individuals to use the system, component, or service in a more secure manner.			X	X			Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.1 Software Applications 1.9.8.2.1 HVAC Control System Devices FULLY S... 1.9.8.2.2 All Other HVAC Control System Devic... 1.9.8.3.1 Lighting Control System Devices FUL... 1.9.8.3.2 All Other Lighting Control System D... 1.9.8.5 Default Requirements for Control Sy...
SA-5	SA-5(b)(3)	CCI-003131	The organization obtains user documentation for the information system, system component or information system service that describes user responsibilities in maintaining the security of the system, component, or service.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide user documentation for the information system, system component or information system service that describes user responsibilities in maintaining the security of the system, component, or service.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide user documentation for the information system, system component or information system service that describes user responsibilities in maintaining the security of the system, component, or service.			X	X			Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.1 Software Applications
SA-11	SA-11(a)	CCI-003171	The organization requires the developer of the information system, system component, or information system service to create a security assessment plan.	The organization being inspected/assessed requires that the developer create and document a security assessment plan that includes: 1. The types of analyses, testing, evaluation, and reviews of software and firmware components; 2. The degree of rigor to be applied; and 3. The types of artifacts produced during those processes.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer of the information system, system component, or information system service create a security assessment plan.			X	X	X		Designer Non-Designer Impractical	3.14 CONTROL SYSTEM CYBERSECURITY TESTIN...
SA-11	SA-11(a)	CCI-003172	The organization requires the developer of the information system, system component, or information system service to implement a security assessment plan.	The organization being inspected/assessed requires that the developer implement the security assessment plan developed in SA-11, CCI 003171.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer of the information system, system component, or information system service implement a security assessment plan.			X	X	X		Designer Non-Designer Impractical	3.14 CONTROL SYSTEM CYBERSECURITY TESTIN...
SA-11	SA-11(b)	CCI-003173	The organization requires the developer of the information system, system component, or information system service to perform unit, integration, system, and/or regression testing/evaluation at organization-defined depth and coverage.	The organization being inspected/assessed documents within the contracts/agreements, the requirement that the developer of the information system, system component, or information system service perform unit, integration, system, and/or regression testing/evaluation at depth and coverage defined in SA-11, CCI 3174.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer of the information system, system component, or information system service perform unit, integration, system, and/or regression testing/evaluation at depth and coverage defined in SA-11, CCI 3174.			X	X	X		Designer Non-Designer Impractical	3.14 CONTROL SYSTEM CYBERSECURITY TESTIN...

SA-11	SA-11(b)	CCI-003174	The organization defines the depth and coverage to perform unit, integration, system, and/or regression testing/evaluation.	The organization being inspected/assessed defines and documents the depth and coverage to perform unit, integration, system, and/or regression testing/evaluation. Examples of approaches or tool types that could be required are: 1. Approaches such as static analyses, dynamic analyses, binary analysis, or a hybrid of the three approaches; and 2. Tools such as web-based application scanners, static analysis tools, binary analyzers. DoD has determined the depth and coverage are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented depth and coverage to ensure the organization being inspected/assessed defines the depth and coverage to perform unit, integration, system, and/or regression testing/evaluation. DoD has determined the depth and coverage are not appropriate to define at the Enterprise level.			X	X	X	Designer Non-Designer Impractical	3.14 CONTROL SYSTEM CYBERSECURITY TESTIN...
SA-11	SA-11(c)	CCI-003175	The organization requires the developer of the information system, system component, or information system service to produce evidence of the execution of the security assessment plan.	The organization being inspected/assessed requires the developer to produce and provide evidence of the execution of the security assessment plan.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer of the information system, system component, or information system service produce evidence of the execution of the security assessment plan.			X	X	X	Designer Non-Designer Impractical	3.14 CONTROL SYSTEM CYBERSECURITY TESTIN...
SA-11	SA-11(c)	CCI-003176	The organization requires the developer of the information system, system component, or information system service to produce the results of the security testing/evaluation.	The organization being inspected/assessed requires the developer to produce and provide results of the security testing/evaluation.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer of the information system, system component, or information system service produce the results of the security testing/evaluation.			X	X	X	Designer Non-Designer Impractical	3.14 CONTROL SYSTEM CYBERSECURITY TESTIN...
SA-11	SA-11(d)	CCI-003177	The organization requires the developer of the information system, system component, or information system service to implement a verifiable flaw remediation process.	The organization being inspected/assessed requires the developer to implement a verifiable flaw remediation process.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer of the information system, system component, or information system service implement a verifiable flaw remediation process.			X	X	X	Designer Non-Designer Impractical	3.14 CONTROL SYSTEM CYBERSECURITY TESTIN...
SA-11	SA-11(e)	CCI-003178	The organization requires the developer of the information system, system component, or information system service to correct flaws identified during security testing/evaluation.	The organization being inspected/assessed requires the developer to correct flaws identified during security testing/evaluation and to document and provide evidence that the flaws were corrected.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer of the information system, system component, or information system service correct flaws identified during security testing/evaluation and provide evidence.			X	X	X	Designer Non-Designer Impractical	3.14 CONTROL SYSTEM CYBERSECURITY TESTIN...
SA-22	SA-22(b)	CCI-003374	The organization documents approval for the continued use of unsupported system components required to satisfy mission/business needs.	The organization being inspected/assessed documents approval for the continued use of unsupported system components required to satisfy mission/business needs.	The organization conducting the inspection/assessment obtains and examines the hardware and software lists as well as the documented approvals to ensure the organization being inspected/assessed documents approval for the continued use of unsupported system components required to satisfy mission/business needs.							---

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 25 05 11.02

CYBERSECURITY FOR LOW IMPACT LIGHTING CONTROL SYSTEM (LCS) FACILITY-RELATED CONTROL SYSTEMS 08/24

PART 1 GENERAL

Many subparts in this Section contain text in curly braces ("{" and "}") indicating which cybersecurity control and control correlation identifier (CCI) the requirements of the subpart relate to. The text inside these curly braces is for Government reference only and enables coordination of the requirements of this Section with the RMF process throughout the design and construction process. Text in curly braces are not contractor requirements.

This Section refers to Security Requirements Guide (SRGs) and Security Technical Implementation Guide (STIGs). STIGs and SRGs are available online at the Information Assurance Support Environment (IASE) website at <https://public.cyber.mil/stigs/downloads/> and an SRG/STIG Applicability Guide and Collection Tool is available at <https://public.cyber.mil/stigs/SCAP/>. Not all control system components have applicable STIGs or SRGs. The "Control Systems SRG" does not apply to work performed under this Section; all requirements within this section to apply applicable SRGs DO NOT include the "Control Systems SRG".

1.1 CONTROL SYSTEM APPLICABILITY

There are multiple versions of this Section associated with this project. Different versions have requirements applicable to different control systems. This specific Section applies only to the following control system: Lighthing Control System (LCS). This system has a CIA Impact Level of LLL.

1.2 RELATED REQUIREMENTS

This section does not contain sufficient requirements to procure a control system and must be used in conjunction with other Sections which specify control systems. This Section adds cybersecurity requirements to the control systems specified in other Sections, and as these requirements are conditioned on the control system being provided, there may be requirements in this Section that will not apply to this project. All Sections containing facility-related control systems or control system components are related to the requirements of this Section. Review all specification sections to determine related requirements.

In cases where a requirement is specified in both this Section and in another Section, the more stringent requirement must be met. In cases where a requirement in this Section conflicts with the requirements of another Section such that both requirements cannot be met at the same time, request direction from the Contracting Officer to determine which requirement applies to the project.

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.1x (2010) Local and Metropolitan Area
Networks - Port Based Network Access
Control

INTERNET ENGINEERING TASK FORCE (IETF)

IETF RFC 2819 (2000) Remote Network Monitoring (RMON)
Management Information Base (MIB)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST FIPS 140-2 (2001) Security Requirements for
Cryptographic Modules

NIST FIPS 201-2 (2013) Personal Identity Verification
(PIV) of Federal Employees and Contractors

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 8551.01 (2014) Ports, Protocols, and Services
Management (PPSM)

DTM 08-060 (2008) Policy on Use of Department of
Defense (DoD) Information Systems -
Standard Consent Banner and User Agreement

1.4 DEFINITIONS

1.4.1 Administrator Account

An administrator account is an account with full permissions to a device, application, or operating system, including the ability to create and modify other user accounts.

Note that the operating system Administrator Account may be different than Administrator Accounts for applications hosted on that operating system. Also, most controllers will not have any support for accounts and will therefore not have an 'Administrator Account'.

1.4.2 Computer

A computer is one of the following:

- a. a device running a non-embedded desktop or server version of Microsoft Windows
- b. a device running a non-embedded version of MacOS
- c. a device running a non-embedded version of Linux
- d. a device running a version or derivative of the Android Operating System, where Android is considered separate from Linux
- e. a device running a version of Apple iOS

Unless otherwise indicated or clear from context use of the word "device"

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

in this Section includes computers.

1.4.3 Controller

A device other than a computer or Ethernet switch.

1.4.4 Mission Space

A device or media is in mission space if physical access to the device or media is controlled by the organization served by the device. For example, a variable air volume (VAV) box controller in a suspended ceiling is in mission space if the VAV box serves that room; an electrical switchgear in an electrical room or an air handling unit (AHU) in a mechanical room or on a rooftop may still be considered to be in mission space if the organization (mission) served by that switchgear or AHU controls access to the electrical room, mechanical room or rooftop.

1.4.5 Network

A network is a group of two or more devices that can communicate using a network protocol. Network protocols must provide a method for addressing devices on the network; a communication method that does not provide an addressing scheme is not a networked form of communication. Devices that communicate using a method of communication that does not support device addressing are not using a network. Addresses may be other than IP addresses, and addressing may be at either Open Systems Interconnection (OSI) layer 2 or layer 3.

1.4.6 Network Connected

A component is network connected (or "connected to a network") only when the device has a network transceiver which is directly connected to the network and implements the network protocol. A device lacking a network transceiver (and accompanying protocol implementation) can never be considered network connected. Note that (unlike many IT definitions of "Network Connected") a device connected to a non-IP network is still considered network connected (an IP connection or IP address is not required for a device to be network connected).

1.4.6.1 Wireless Network Connected

Any device that supports wireless network communication is network connected to a wireless network, regardless of whether the device is communicating using wireless. Unless physically disabled, devices with wireless transceivers support wireless, it is not sufficient to disable the wireless in software.

1.4.7 Network Media

The thing that provides the communication channel between the devices on a network. Typically wire, but might include wireless, fiber optic, or even power line (some network protocols allow sending network signals over power wiring).

1.4.8 User Account Support Levels

The support for user accounts is categorized in this Section as one of three levels:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4.8.1 FULLY Supported

Device supports configurable individual accounts. Accounts can be created, deleted, modified, etc. Privileges can be assigned to accounts. These devices support user-based (as opposed to role-based) authentication.

1.4.8.2 MINIMALLY Supported

Device supports a small, fixed number of accounts (perhaps only one). Accounts cannot be modified. A device with only a "User" and an "Administrator" account would fit this category. Similarly, a device with two PINs for logon - one for restricted and one for unrestricted rights would fit here (in other words, the accounts do not have to be the traditional "username and password" structure). These devices typically only support role-based authentication.

Examples of devices which MINIMALLY support accounts are a) a variable frequency drive with a single account which requires a PIN for access to configuration; and b) a room lighting control touchpad interface that has a single account.

1.4.8.3 NOT Supported

Device does not support any Access Enforcement therefore the whole concept of "account" is meaningless.

1.4.9 Manual Local Input

Manual Local Inputs are system analog or binary inputs that are adjustable by a person but are, by intrinsic hardware design, very limited in potential capabilities. Manual Local Inputs do not have touch screens or full keyboards, but may have a few buttons or dials to allow input. Manual Local Inputs do not have full graphic screens or dot-matrix displays, but may have simple lights (LEDs) or 7-segment displays. Manual Local Inputs do not have any sort of menu structure, each button has a single well-defined function.

Examples of Manual Local Inputs are H-O-A switches, simple thermostats, and disconnect switches.

1.4.10 Card Reader

A card reader is an input/output device whose primary function is to assist in two-factor authentication. A card reader must have an interface to read data from a card and may be able to write data to a card. A card reader may have a means (such as buttons, keypad, touchscreen, etc.) for a user to input a PIN or password, as well as a limited display.

1.4.11 User Interface

A User Interface (UI) is something other than a Manual Local Input or Card Reader that allows a person to interact with the system or device. Note that while a Card Reader is not by itself a User Interface, a User Interface may contain a Card Reader in order for it to authenticate its user. Within control systems, there are a wide range of User Interfaces.

Two important distinctions are 1) whether the user interface is Local or Remote, and 2) the effective capabilities of the User Interface to alter data, which is the "privilege" of the user interface (where effective

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

privilege available to a specific user at a specific user interface is the combination of the greatest privilege offered by the user interface and the specific account the user is logged into).

1.4.11.1 Local User Interface

A Local User Interface is a user interface where the physical hardware the user interacts with (keyboard, buttons, display, etc.) is physically part of the device being affected. All of the relevant characteristics of the user interface are embodied within a single device.

Note that a Local UI may be able to access data in a different device, Local versus Remote in this context refers to the user interface itself; the capability to access data in a different device is covered under "Full User Interface".

1.4.11.2 Remote User Interface

A Remote User Interface implements a Client/Server model where the physical hardware the user interacts with (Client) is physically distinct from the device being affected (Server). Most or all of the security and functionality characteristics of the user interface are defined by the Server, not the Client. The Client and Server communicate via a network connection. A common example of a remote user interface is a web-based interface where the browser (client) is generally on different hardware than the web server (server). A Remote UI remains a Remote UI even if the user happens to be at a Client on the same hardware as the Server. What is important is that a) the Client may be on different hardware than the Server and b) the majority of the security and functional characteristics of the interface are defined at the Server.

Note that this definition of "remote" is consistent with that generally used in the control industry but is not aligned with the NIST 800-53 definition of "Remote", which refers to "outside the system". The term "Remote" here better aligns with the NIST 800-53 definition of "Network" (remote from within the system) Access.

1.4.11.3 Types of User Interface (by capability)

User interfaces are also categorized by their capabilities as being Read Only, Limited, or Full.

1.4.11.3.1 Read-Only User Interface

A Read Only User Interface (also referred to as a View-Only User Interface) is a user interface that only allows for reading data, it does not allow (have the capability to) modify data. A Read Only User Interface may be either Local or Remote. A User Interface that is configured to be Read Only (by some other means than the interface itself, such as using configuration software on a laptop) is a Read-Only Interface. Note a Read Only User Interface may have buttons (or touch screen, etc.) allowing the user to navigate through the presentation of data.

Examples of a Read Only User Interfaces are a) a publicly viewable "energy dashboard" showing weather data and energy usage within a building and b) digital wayfinding signage.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.4.11.3.2 Limited User Interface

A Limited User Interface is a user interface that - by design - can only alter information local to the user interface. Note that the determination of "alter" includes only direct interactions, it explicitly excludes interactions that might occur as secondary effects. For example, an interface changing the flow setpoint in a pump controller is a direct interaction, the subsequent change in flow (as well as any subsequent downstream changes in valve position) are not direct interactions.

Two examples of LIMITED UIs are: a) a variable speed drive has a Limited Local User Interface which allows the user to change properties within the drive, but does not allow affecting things outside the drive; and b) a typical home WiFi Router has a Limited Remote User Interface which allows configuration of the Router, but does not allow direct interaction with other devices.

1.4.11.3.3 Full User Interface

A Full User Interface can alter information in devices outside the device with the user interface. For example, a typical Local Display Panel is a Full Local User Interface while a browser-based front end is a Full Remote User Interface.

1.4.11.3.4 View-Only User Interface

See Read-Only User Interface

1.4.11.4 Other User Interface Terminology

In addition to defining whether a user interface is a Hardware Limited, Read-Only, Limited or Full, and whether it is Local or Remote, user interfaces are classified by whether they are writable or privileged.

1.4.11.4.1 Writable User Interface

Any User Interface that is not Read-Only is Writable. (Limited User Interfaces and Full User Interfaces are both writable user interfaces (as they are capable of changing a value)).

1.4.11.4.2 Privileged User Interface

A Privileged UI is a UI that has sufficient capabilities or functionality that it requires specific cybersecurity measures to be put in place to limit its unauthorized use. Ultimately, whether a specific user interface is considered a Privileged User Interface must be determined by usage. Unless otherwise specified, user interfaces can be determined to be privileged or not using the following:

- a. Read-Only User Interfaces are not privileged user interfaces.
- b. Full User Interfaces are privileged user interfaces.
- c. User interfaces that allow for configuration of auditing or allows for modification or deletion of audit logs are privileged user interface.
- d. User interfaces that allow for reprogramming a network connected device is a privileged user interface.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- e. Except as specified above, a Limited User Interface must be determined to be privileged or not based on the specific capabilities and use case of the user interface. In general however, user interfaces that do not offer significant capabilities above and beyond those available at that location via other means (e.g. such as a disconnect switch, breaker, or hand-off-auto switch, or physical attack) are not privileged.

1.4.12 Wireless Network

Any network that communicates without using wires or fiber optics as the communication media. Wireless networks include: WiFi, Bluetooth, ZigBee, cellular, satellite, long and short wave radio, 2.4 GHz, free space optical, point-to-point laser, microwave, and IR.

1.4.13 Wired Broadcast Network

Wired Broadcast Networks are any network, such as powerline carrier networks and modem (wired telephony), that use wire-based technologies where there is not a clearly defined boundary for signal propagation.

1.5 ADMINISTRATIVE REQUIREMENTS

1.5.1 Points of Contact

Coordinate with the following Points of Contact as indicated in this Section and as required. Not all projects will require coordination with all Points of Contact. When coordination is required and no Point of Contact is indicated, coordinate with the Contracting Officer (K0).

- a. Government Computer Access Point of Contact: Contracting Office (K0)
- b. HTTPS Certificate Point of Contact: Contracting Officer (K0)
- c. Email Address Point of Contact: Contracting Officer (K0)
- d. Password Point of Contact: Contracting Officer (K0)
- e. Mobile Code Point of Contact: Contracting Officer (K0).

1.5.2 Coordination

Coordinate the execution of this Section with the execution of all other Sections related to control systems as indicated in the paragraph RELATED REQUIREMENTS. Items that must be considered when coordinating project efforts include but are not limited to:

- a. If requesting permission for wireless or wired broadcast communication, the Wireless and Wired Broadcast Communication Request submittal must be approved prior to control system device selection and installation.
- b. If requesting permission for alternate account lock permissions, the Device Account Lock Exception Request must be approved prior to control system device selection and installation.
- c. If requesting permission for the use of a device with multiple physical connections to IP networks, the Multiple IP Connection Device Request must be approved prior to control system device selection and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

installation.

- d. Wireless testing may be required as part of the control system testing. See requirements for the Wireless Communication Test Report submittal.
- e. If the Device Audit Record Upload Software is to be installed on a computer not being provided as part of the control system, coordination is required to identify the computer on which to install the software.
- f. The Cybersecurity Interconnection Schedule must be coordinated with other work that will be interconnected to, and interconnections must be approved by the Government before relying on them for system functionality.
- g. Cybersecurity testing support must be coordinated across control systems and with the Government cybersecurity testing schedule.
- h. Passwords must be coordinated with the indicated contact for the project site.
- i. If applicable, HTTPS web server certificates must be obtained from the indicated HTTPS Certificate Point of Contact.
- j. Contractor Computer Cybersecurity Compliance Statements must be provided for each contractor using contractor owned computers.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor Computer Cybersecurity Compliance Statements; G
Contractor Temporary Network Cybersecurity Compliance Statements; G
Cybersecurity Interconnection Schedule ; G
Pre-Construction Control System Inventory Report ; G

SD-02 Shop Drawings

Network Communication, Ports, Protocols and Services Report; G
Cybersecurity Network (Riser) Diagram ; G
Control System Inventory Report; G

SD-03 Product Data

Control System Cybersecurity Documentation; G

SD-07 Certificates

Software Licenses; G

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SD-11 Closeout Submittals

Enclosure Keys (if applicable); G

Software and Configuration Backups (if applicable); G

System Maintenance Tool Software (if applicable); G

1.7 QUALITY CONTROL

1.7.1 Cybersecurity Subject Matter Expert Requirements

Cybersecurity Subject Matter Expert position, resumes should be submitted to the government within 14 days after Notice to Proceed. All certifications must be in effect prior to being hired. This position may serve across the contract.

1.7.2 Cybersecurity Subject Matter Expert Qualifications

The individual will oversee all work within this section. This position requires that the individual currently meets Information Assurance Technical Level II Certification in accordance with DoDI 8570 Information Workforce Improvement Program. Individuals for this position must have a minimum of two years experience securing DoD Systems and with Risk Management Framework. They must also have experience with Facility-Related Control Systems cybersecurity implementation such as control system-related training or certification. The individual is required to have a background check and be able to obtain a Common Access Card (CAC).

1.7.3 Cybersecurity Kickoff Meeting

Within 60 calendar days after contract award, the Cybersecurity Subject Matter Expert must schedule a Cybersecurity Kickoff Meeting with the Contracting Officer, System Owner, System Program Manager, and Information System Security Manager (ISSM).

1.8 CYBERSECURITY DOCUMENTATION

{For Government Reference Only: This subpart (and its subparts) relates to PL-7; CCI-003071}

1.8.1 Cybersecurity Interconnection Schedule

{For Government Reference Only: This subpart relates to CA-3(b), PL-8, SC-7(9), SC-7(11); CCI-000258, CCI-003072, CCI-003073, CCI-003075, CCI-002398, CCI-002399, CCI-002401, CCI-002402, CCI-002403. For MODERATE Impact systems, this subpart also relates to SC-7; CCI-001126, CCI-001109}

Provide a completed Cybersecurity Interconnection Schedule documenting network connections between the installed system and other systems. Provide the following information for each device directly communicating between systems: Device Identifier, Device Manufacturer, Device Description, Transport layer Protocol, Network Address, Port (if applicable), MAC (Layer 2) address (if applicable), Media, Application Protocol, Service (if applicable), Descriptive Purpose of communication. For communication with other authorized systems also provide the Foreign Destination and POC for Destination. For MODERATE Impact Systems: Also describe the impact of loss of the connection on the control system. If

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Cybersecurity Interconnection Schedule as an editable Microsoft Excel file (a template Cybersecurity Interconnection Schedule in Excel format is available at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1>)

1.8.2 Network Communication, Ports, Protocols and Services Report

{For Government Reference Only: This subpart (and its subparts) relates to CA-9, PL-8; CCI-002102, CCI-002103, CCI-002104, CCI-002105, CCI-003072, CCI-003073, CCI-003075 and also the submittal requirements associated with CM-6, CM-7, including CM-7(3), CCI-000388.}

Provide a Network Communication, Ports, Protocols and Services Report. For each networked device, document device identifier and the communication characteristics of the device including communication protocols, services used, encryption employed, and a general description of what information is communicated over the network. For each device using IP communication, document all TCP and UDP ports used. For each device using non-IP communication, document communication protocol and media used. If other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Network Communication, Ports, Protocols and Services Report as an editable Microsoft Excel file.

1.8.3 Control System Inventory Reports

{For Government Reference Only: This subpart (and its subparts) relates to CM-8(a), SI-17, IA-3; CCI-000389, CCI-000392, CCI-000398, CCI-002773, CCI-002774, CCI-002775, CCI-000777, CCI-000778, CCI-001958}

Provide a Pre-Construction Control System Inventory Report report and a Final Control System Inventory Report, using the Inventory Spreadsheet listed under this Section at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1> In the Control System Inventory Reports, document all networked devices, including network infrastructure devices. For each device provide all applicable information for which there is a field on the spreadsheet in accordance with the instructions on the spreadsheet.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Control System Inventory Reports as editable Microsoft Excel files. Provide the Pre-Construction Control System Inventory Report concurrently with the Proposed STIG and SRG Applicability Report

1.8.4 Cybersecurity Network (Riser) Diagram

{For Government Reference Only: This subpart (and its subparts) relates to PL-2(a), PL-8; CCI-003051, CCI-003053, CCI-003072, CCI-003073, CCI-003075}

Provide a cybersecurity network (riser) diagram of the complete control

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

system including all network and device hardware. For each device, include the device identifier, device type, and manufacturer. If the control system specifications require a riser diagram submittal, provide a copy of that submittal as the cybersecurity riser diagram. Otherwise, provide a riser diagram in one-line format.

1.8.5 Control System Cybersecurity Documentation

{For Government Reference Only: This subpart (and its subparts) relates to SA-5(a), SA-5(b), SA-5(c), SA-22(b); CCIs: CCI-003124, CCI-003125, CCI-003126, CCI-003127, CCI-003128, CCI-003129, CCI-003130, CCI-003131, CCI-003374}

Provide a Control System Cybersecurity Documentation submittal containing the indicated information for each device and software application.

1.8.5.1 Software Applications

For all software applications running on computers provide:

- a. administrator documentation that describes secure configuration of the software {For Government Reference Only: relates to CCI-003124}
- b. administrator documentation that describes secure installation of the software and software updates. {For Government Reference Only: relates to CCI-003125}
- c. administrator documentation that describes secure operation of the software {For Government Reference Only: relates to CCI-003124}
- d. administrator documentation that describes effective use and maintenance of security functions or mechanisms for the software {For Government Reference Only: relates to CCI-003127}
- e. administrator documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the software {For Government Reference Only: relates to CCI-003128}
- f. user documentation that describes user-accessible security functions or mechanisms in the software and how to effectively use those security functions or mechanisms {For Government Reference Only: relates to CCI-003129}
- g. user documentation that describes methods for user interaction which enables individuals to use the software in a more secure manner {For Government Reference Only: relates to CCI-003130}
- h. user documentation that describes user responsibilities in maintaining the security of the software {For Government Reference Only: relates to CCI-003131}

1.8.5.2 Default Requirements for Control System Devices

For control system devices where Control System Cybersecurity Documentation requirements are not otherwise indicated in this Section, provide:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- a. Documentation that describes secure configuration of the device {For Government Reference Only: relates to CCI-003124}
- b. Documentation that describes secure installation of the device {For Government Reference Only: relates to CCI-003125}
- c. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}
- d. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government Reference Only: relates to CCI-003127}
- e. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {For Government Reference Only: relates to CCI-003128}
- f. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms {For Government Reference Only: relates to CCI-003129}
- g. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {For Government Reference Only: relates to CCI-003130}
- h. Documentation that describes user responsibilities in maintaining the security of the device {For Government Reference Only: relates to CCI-003131}
- i. Documentation of the published last date of support by the manufacturer or indication that a published date is not available. {For Government Reference Only: relates to CCI-003374}

1.9 SOFTWARE LICENSING

{For Government Reference Only: This subpart (and its subparts) relates to SI-2(a), SI-2(c), SI-7(14); CCI-001227, CCI-002605, CCI-002737}

For all software provided that has not already been licensed to the government or project site, provide a license to the Government for a period of no less than 5 years, and the license must also include the following software updates:

- a. Security and bug-fix patches issued by the software manufacturer.
- b. Security patches to address any vulnerability identified in the National Vulnerability Database at <http://nvd.nist.gov> with a Common Vulnerability Scoring System (CVSS) severity rating of MEDIUM or higher.

Provide a single Software Licenses submittal with documentation of the software licenses for all software provided

1.10 CYBERSECURITY DURING CONSTRUCTION

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, CA-3; CCI-000258}

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

1.10.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. Contractor computers connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.10.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

1.10.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates, and must use the latest definitions file. Computers used on this project must perform a full antivirus scan at least once per day. Computers which have connected to any other network since the last full antivirus scan must perform a full antivirus scan prior to connection to the control system network or to the temporary contractor-installed IP network. Perform an antivirus scan on all removable media (e.g., external hard drives, CDs, DVDs, USB flash drives) prior to connecting to the control system environment.

1.10.1.3 Passwords and Passphrases

The passwords and passphrases for computers, applications, and web-based applications supporting passwords must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.10.1.4 User-Based Authentication

Each user must have a unique account; sharing of a single account between multiple users is prohibited.

1.10.1.5 Demonstration of Compliance

The Government has the right to require demonstration of computer compliance with these requirements at any time during the project.

1.10.1.6 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using contractor owned computers. Contractor Computer Cybersecurity Compliance Statements must use the template published at

<https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1>
Each Statement must be signed by a cybersecurity representative for the relevant company.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.10.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.10.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than those specifically provided or furnished for this project. Any and all access to the network from outside the project site is prohibited.

1.10.3 Government Access to Network

Government personnel must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification.

1.10.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks, when permitted, must not interfere with existing wireless networks, must use WPA2 security and must not broadcast the network name (SSID). Network names (SSID) for wireless networks must be changed from their default values.

1.10.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.10.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. Contractor Temporary Network Cybersecurity Compliance Statements must use the template published at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1> Each Statement must be signed by a cybersecurity representative for the relevant company. If no temporary IP networks will be used, provide a single copy of the Statement indicating this.

1.11 CYBERSECURITY DURING WARRANTY PERIOD

All work performed on the control system after acceptance must be performed using Government Furnished Equipment or equipment specifically and individually approved by the Government.

PART 2 PRODUCTS

All products used on this project must meet the indicated requirements, but not all products specified here will be required by every project.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.1 ETHERNET SWITCH

Provide Open Systems Interconnection (OSI) Layer 2 Ethernet switches with the following capabilities, and with an interface to support switch configuration for these capabilities:

2.1.1 Required Functionality

Switches must:

- a. Copper Ethernet ports must auto negotiate for 10, 100 and 1000 megabits-per-second links.
- b. Be capable of implementing port level access control by MAC address and limit the number of MAC addresses to one MAC address per port.
- c. For MODERATE Impact Systems, be capable of implementing per-port access control lists (ACLs) where the list can be filtered by source and destination IP addresses, and by source and destination UDP or TCP ports.
- c. For LOW Impact Systems, be capable of implementing per-port access control lists (ACLs) where the list can be filtered by source and destination IP addresses, and by source and destination UDP or TCP ports.
- d. Support Remote Network Monitoring (RMON) Port Analysis in accordance with IETF RFC 2819
- e. Configure target port and analysis port such that switch clones all target port traffic to analysis port.
- f. Support authentication via RADIUS server (for management and 802.1x)

2.1.2 Configuration Requirements

Switches must:

- a. Support configuration save and restore.
- b. Support both manual IP address assignment and acquisition of a dynamic IP address via Dynamic Host Configuration Protocol (DHCP).
- c. Be capable of limiting access for configuration to one or more of: a web interface using HTTPS, a command line interface using SSH, or an SNMP connection using SNMP version 3 or later.

2.2 DAISY CHAIN IP CONTROLLERS

Controllers used as Daisy Chain IP Controllers must be IP controllers with exactly two Ethernet network connections and basic built-in switch capabilities to allow implementation of an Ethernet network in a daisy chain architecture. Switches incorporated by Daisy Chain IP Controllers are not required to meet the requirements for Ethernet Switches as defined in this Section.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.3 DATABASE AND WEB SERVER SOFTWARE FOR MODERATE IMPACT SYSTEMS

{For Government Reference Only: This subpart (and its subparts) relate to RA-5(1), RA-5(5); CCI-001062, CCI-001067, CCI-001645, CCI-002906}

All computer-based databases must use Microsoft SQL Server, Oracle or MySQL. All computer-based web interfaces must use Internet Information Services (IIS) or Apache as the web server.

PART 3 EXECUTION

3.1 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES

Install, configure, and harden all hardware and software furnished on this project in accordance with manufacturer provided documentation, procedures, or methods for secure configuration or installation. Do not implement specific hardening actions if that action would conflict with required functionality or another requirement of this Section.

3.2 NETWORK REQUIREMENTS

3.2.1 Information Flow Enforcement In MODERATE Impact Systems

{For Government Reference Only: This subpart (and its subparts) relate to AC-4; CCI-001368, CCI-001414, CCI-001548, CCI-001549, CCI-001550, CCI-001551}

Install and configure Ethernet switches to block all traffic on all ports not required by the control protocol.

3.2.2 Wireless and Wired Broadcast Communication

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, AC-18(3); CCI-001438, CCI-001439, CCI-002323, CCI-001441, CCI-001449}

Unless explicitly authorized by the Government, do not use any wireless or wired broadcast communication.

3.2.2.1 Wireless and Wired Broadcast IP Communications

Do not install wireless or wired broadcast IP networks, including: do not install a wireless access point; do not install or configure an ad-hoc wireless network; do not install or configure a WiFi Direct communication.

When explicitly authorized by the Government, wireless IP communication may be used to communicate with an existing wireless network.

3.2.2.2 Non-IP Wireless Communication

For LOW Impact Systems: When non-IP wireless communication is explicitly authorized by the Government, use the maximum level of encryption supported by the specific protocol employed and select signal strength and radiated power to the minimum necessary for reliable communication.

For MODERATE Impact Systems: When non-IP wireless communication is explicitly authorized by the Government, the radios must meet NIST FIPS 140-2 Level 2.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2.2.3 Wireless and Wired Broadcast Communication Request

Provide a report documenting the proposed use of wireless or wired broadcast communication prior to device selection using the Wireless and Wired Broadcast Communication Request Schedule at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1>. If there is no proposed use of wireless or wired broadcast communication, provide a document indicating this instead of the Request Schedule.

For each device proposed to use wireless or wired broadcast communication show: the device identifier, a description of the device, the location of the device, the device identifiers of other devices communicating with the device, the protocol used for communication, encryption type and strength. For wireless communication, also show: RF Frequency, Radiated Power in dBm (decibel with a milliwatt reference), free-space range, and the expected as-installed range.

3.2.3 Non-IP Control Networks

When control system specifications require particular communication protocols, use only those communication protocols and only as specified. Do not implement any other communication protocol.

When control system specifications do not indicate requirements for communication protocols, use only those protocols required for operation of the system as specified.

3.2.4 IP Control Networks

{For Government Reference Only: This subpart relates to CM-6(a), CM-7(a), CM-7(b), CM-7(1)(b), SC-41; CCI-001588, CCI-000381, CCI-000380, CCI-000381, CCI-000382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546. For Moderate Impact Systems, this subpart (and its subparts) also relates to SC-5(1), SC-5(2); CCI-001094 CCI-001095}

IP Networks must be Ethernet networks and must use switches which are Ethernet Switches or Daisy Chain IP Controllers as defined in this Section. Do not use nonsecure functions, ports, protocols and services as defined in DODI 8551.01 unless those ports, protocols and services are specifically required by the control system specifications or otherwise specifically authorized by the Government. Do not use ports, protocols and services that are not specified in the control system specifications or required for operation of the control system.

For MODERATE Impact Systems, unless explicitly authorized, do not use IP networks if the same control functionality is available through the use of non-IP networks.

3.2.4.1 IP Network Routers

Do not install any device that performs IP routing.

3.2.4.2 IP Devices With Multiple Ethernet Connections

Except for Ethernet Switches and Daisy Chain IP Controllers, devices must not have more than one Ethernet connection to IP networks unless doing so is required by the project specifications and the specific application is approved. If a device with Multiple Ethernet Connections to IP networks is required, provide a Multiple Ethernet Connection Device Request using

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

the Multiple Ethernet Connection Device Request Template at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1> to request approval for each device. If a device with Multiple Ethernet Connections to IP networks is not required, instead provide a document stating that no approval is being requested.

3.2.5 Cryptographic Protection

{For Government Reference Only: This subpart relates to IA-2(9), IA-3(1), SC-8, SC-13, SC-23(1), SC-23(3); CCI-001942, CCI-001959, CCI-001967, CCI-002418, CCI-002449, CCI-002450, CCI-001185, CCI-001188, CCI-001664.}

All remote user interfaces must use HTTPS for all traffic between the user interface client and user interface server.

3.2.6 Device Identification and Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-3; CCI-000777, CCI-000778, CCI-001958. For MODERATE Impact systems, this subpart (and its subparts) also relates to SC-23, SC-23(5); CCI-001184, CCI-002470.}

All computers must support IEEE 802.1x for device authentication to the network.

3.2.6.1 Default Requirements for Control System Devices

For control system devices where Device Identification and Authentication requirements are not otherwise indicated in this Section: Devices using HTTP as a control protocol must use HTTPS instead.

3.2.7 Cryptographic Module Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-7; CCI-000803}

For devices (including but not limited to NIST FIPS 140-2 compliant radios) that have STIG/SRGs related to cryptographic module authentication (CCI-000803), comply with the requirements of those STIG/SRGs.

3.3 ACCESS CONTROL REQUIREMENTS

3.3.1 User Accounts

{For Government Reference Only: This subpart (and its subparts) relate to AC-2(a), AC-3, AC-6(1), AC-6(10), AC-6(2), AC-6(9), CM-11(2), and IA-2; CCI-002110, CCI-000213, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-001812, and CCI-000764.

For MODERATE Impact systems, this subpart (and its subparts) also relate to AC-2 (2), AC-2(3), AC-2(4), AC-6(1), and CM-5(1); CCI-001361, CCI-000017, CCI-000217, CCI-000018, CCI-001403, CCI-001404, CCI-001405, CCI-002130, CCI-001683, CCI-001684, CCI-001685, CCI-001686, CCI-002132, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-001813.}

Any user interface supporting user accounts (either FULLY or MINIMALLY) must limit access according to specified limitations for each account. Install and configure any device having a STIG or SRG in accordance with that STIG or SRG.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

All user interfaces FULLY supporting accounts must implement user-based authentication where each account is uniquely assigned to a specific user. User interfaces FULLY supporting accounts must implement at least three (3) levels of user account privilege including: 1) an account with read-only permissions 2) an account with full permissions including account creation and modification and 3) an account with greater permissions than read-only but without account creation and modification. Disable any unnecessary or unused accounts. Disable any "guest-level" accounts that are created on the system by default.

3.3.1.1 Computers

All computer operating systems must FULLY support user accounts and implement accounts for access. Each control system software application not supporting accounts and running on a computer must be installed such that use of the software is restricted by the computer operating system to specific users.

Applications running on computers must not require the user be logged in to a computer operating system administrator account for normal operation. It is permissible to require the computer operating system administrator account for initial application installation and configuration.

3.3.1.2 Controllers

For user interfaces provided by controllers, provide access control in accordance with the User Interface Requirements table for the applicable control system and user interface type.

- a. For table entries of "NA": NA means Not Applicable, there are no interfaces in this category.
- b. For table entries of "None Required": The user interface is not required to support user accounts.
- c. For table entries of "MINIMALLY": The user interface must at least MINIMALLY support user accounts.
- d. For table entries of "FULLY": The user interface must at FULLY support user accounts.
- e. For table entries of "KEY": The user interface must have physical security in the form of either a key lock on the interface itself or be furnished inside a lockable enclosure. Where this is required for a read only interface, the lockable enclosure must prevent viewing of data on the interface; for other interfaces, this lockable enclosure must prevent using the interface to alter data.
- f. For table entries of "Physical Security": For Local FULL interfaces, the interface must be located inside mission space. For Local Limited (not FULL) interfaces, the user interface must either a) be located within mission space or b) be protected by physical security at least as good as the control devices (and equipment controlled by the control devices) affected by the interface. For purposes of this requirement, 'affected' includes controllers with data that can be directly altered by the interface, as well as mechanical and/or electrical equipment directly controlled by those controllers, but does not include other interactions.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- g. Entries of the form "X and Y" must meet both the requirement indicated for X and the requirement indicated for Y. For example, an entry of "MINIMALLY and Physical Security" indicates the user interface must both MINIMALLY support accounts and have physical security.
- h. Entries of the form "X or Y" must meet either the requirement indicated for X or the requirement indicated for Y.

3.3.1.2.1 Default Requirements for Other Control Systems

For control system devices where User Interface Requirements are not otherwise indicated in this Section, use the Default User Interface Requirements tables.

Default User Interface Requirements for LOW Impact Control Systems	
<u>User Interface Type</u>	<u>Access Control Requirement</u>
Local Read Only (see note 1)	None Required
Local Limited, Non-privileged	None Required
Local Limited, Privileged	MINIMALLY
Local Full	MINIMALLY
Remote Read Only	None Required
Remote Limited, Non-Privileged	MINIMALLY
Remote Limited, Privileged AND Remote Full (see note 2)	FULLY
Notes: 1)Local Read Only User Interfaces are always Non-Privileged 2)Remote Full User Interfaces are always Privileged	

Default User Interface Requirements for MODERATE Impact Control Systems	
<u>User Interface Type</u>	<u>Access Control Requirement</u> (See note 3)
Local Read Only (see note 1)	None Required
Local Limited, Non-privileged	None Required
Local Limited, Privileged	MINIMALLY and Physical Security
Local Full	MINIMALLY and Physical Security
Remote Read Only	None Required

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Default User Interface Requirements for MODERATE Impact Control Systems	
<u>User Interface Type</u>	<u>Access Control Requirement</u> (See note 3)
Remote Limited, Non-Privileged	FULLY
Remote Limited, Privileged AND Remote Full (see note 2)	FULLY
Notes: 1)Local Read Only User Interfaces are always Non-Privileged 2)Remote Full User Interfaces are always Privileged 3)Devices outside mission space require physical security protections as indicated (in "PHYSICAL SECURITY IN MODERATE IMPACT SYSTEMS")	

3.3.1.3 Additional User Account Expiration Requirements In MODERATE Impact Systems:

In addition to other user account requirements, user account expiration and auditing must be configured as indicated.

3.3.1.3.1 For Control System Applications Running on Computers

If temporary accounts are supported, expire temporary accounts 72 hours after creation. Expire all other accounts after 35 days of inactivity.

3.3.1.3.2 For Other Control System Devices FULLY Supporting Accounts

If temporary accounts are supported, expire temporary accounts 72 hours after creation. Expire all other accounts after 365 days of inactivity.

3.3.2 Unsuccessful Logon Attempts

{For Government Reference Only: This subpart (and its subparts) relate to AC-7 (a), AC-7 (b); CCI-000043, CCI-000044, CCI-001423, CCI-002236, CCI-002237, CCI-002238}

Except for high availability user interfaces indicated as exempt, devices must meet the indicated requirements for handling unsuccessful logon attempts. If a device cannot meet these requirements, document device capabilities to protect from subsequent logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures in lieu of the indicated requirements without explicit permission from the Government. If no Device Account Lock Exceptions are requested, provide a document stating that no approval is being requested as the Device Account Lock Exception Request.

3.3.2.1 Devices MINIMALLY Supporting Accounts

For LOW Impact Systems: Devices which MINIMALLY (but not FULLY) support accounts are not required to lock based on unsuccessful logon attempts.

For MODERATE Impact Systems: Devices which MINIMALLY (but not FULLY) support accounts must lock the user account after five consecutive failed login attempts and must unlock the user account after 60 minutes have

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

elapsed without an unsuccessful login attempt or by a successful login to a separate administrator account.

3.3.2.2 Devices FULLY Supporting Accounts

Devices which FULLY support accounts must meet the following requirements.

- a. It must lock the user account when three unsuccessful logon attempts occur within a 15 minute interval.
- b. Once an account is locked, the account must stay locked until unlocked by an administrator. If the account being locked is the sole administrator account on the device, the account must stay locked for 1 hour and then automatically unlock.
- c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.3.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

The following high availability interfaces are exempt from unsuccessful logon attempts requirements:

High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements		
User Interface	Location	Action to take in lieu of locking screen
Any local UI for DDC controllers	ANY	Please validate action with ISO/ISSM

3.3.3 System Use Notification

{For Government Reference Only: This subpart (and its subparts) relates to AC-8; CCI-000048, CCI-002247, CCI-002243, CCI-002244, CCI-002245, CCI-002246, CCI-000050, CCI-002248}

3.3.3.1 System Use Notification for Remote User Interfaces

Remote user interfaces must display a warning banner meeting the requirements of DTM 08-060 on screen.

3.3.3.2 System Use Notification for Local User Interfaces

Devices which are connected to a network and have a local user interface must display a warning banner meeting the requirements of DTM 08-060 on the user interface screen if capable of doing so and must have a permanently affixed label with an approved banner from DTM 08-060 if unable to display the warning banner on the screen. Where it is impractical (perhaps due to device size) to affix the label to the device, affix the label to the device enclosure.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Labels must be machine printed or engraved, plastic or metal, designed for permanent installation, must use a font no smaller than 14 point, and must provide a high contrast between font and background colors.

3.3.4 Session Lock and Session Termination Requirements In MODERATE Impact Systems:

{For Government Reference Only: This subpart (and its subparts) relates to AC-11(a), AC-11(b), AC-11(1), AC-12, SC-10; AC-10; CCI-000058, CCI-000059, CCI-000056, CCI-000057, CCI-000060, CCI-002360, CCI-002361, CCI-001133, CCI-001134, CCI-000054, CCI-000055, CCI-002252}

3.3.4.1 Session Termination

When session termination is required for a User Interface, the User Interface must implement session termination a) based on manual initiation, or b) based on lack of activity, or c) based on either manual initiation or lack of activity, as indicated.

Session Termination must result in logging out the user. A logged out User Interface may only perform actions as indicated in the "Permitted Actions Without Identification or Authentication" subpart of this Section or display a publicly viewable image or blank screen. User Interfaces must remain logged out (session terminated) until a user enters correct authentication information, which must initiate a new session. All User Interfaces running on computers and all Remote User Interfaces must also terminate network connections as part of session termination.

3.3.4.2 Session Lock

When session lock is required for a User Interface, the User Interface must implement session lock a) based on manual initiation, or b) based on lack of activity, or c) based on either manual initiation or lack of activity, as indicated.

Session lock must result in the User Interface being suspended and the user interface must display a publicly viewable image or blank screen. No interaction with the user interface must be possible until either a) the same user enters valid authentication information, in which case that session must be continued, or b) until a different user enters valid authentication information at which point the first session must be terminated and a new session initiated for the new user.

3.3.4.3 Session Lock and Termination for Computers

User Interface sessions provided by computer operating systems must support the requirement for both Session Lock and Session Termination. Session Lock and Session Termination must be capable of being initiated by the user and must also be initiated by lack of activity. Session Lock must occur after 15 minutes of inactivity, and Session Termination must occur after 30 minutes total of inactivity (including, not in addition to, the time for Session Lock). When a user initiates a new session, terminate existing sessions if necessary to limit the total number of concurrent sessions to 1.

Other User Interface sessions running on computers (for local user interfaces) or hosted on a computer (for remote user interfaces) and supporting accounts must support user initiation of Session Termination

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

and session lock. Session lock may be initiated by user initiation or automatically after 15 minutes of inactivity. In addition, remote User Interface sessions must also initiate Session Termination after 30 minutes of inactivity unless otherwise indicated in the Session Lock and Termination Exceptions table.

3.3.4.4 Session Lock and Termination for Controllers

Writable Remote User Interfaces must support requirements for Session Termination, and must both be capable of being initiated by the user and initiated by lack of activity. Session Termination must initiate after 30 minutes of inactivity.

Local User Interfaces supporting accounts must support manual initiation of Session Termination. Privileged Local User Interfaces must also support timed initiation of Session Termination, with Session Termination initiated at 30 minutes of inactivity. They must also support session lock, where session lock may be initiated by user initiation or automatically after 15 minutes of inactivity.

3.3.5 Permitted Actions Without Identification or Authentication

{For Government Reference Only: This subpart (and its subparts) relates to AC-14; CCI-000061, CCI-000232}

The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.

3.3.6 Physical Security in MODERATE Impact Systems

{For Government Reference Only: This subpart relates to PE-3(1), PE-4, PE-5, SC-7(a), SC-7(c), SC-8, SC-8(1); CCI-000928, CCI-002926, CCI-000936, CCI-002930, CCI-002931, CCI-000937, CCI-001097, CCI-001109, CCI-002418, CCI-002419, CCI-002421.}

3.3.6.1 Physical Security for Media

3.3.6.1.1 Physical Security for Media Inside Mission Space

Install all non-IP network media located inside of the mission space in conduit. Install all IP network media located inside of the mission space in intermediate metallic conduit.

3.3.6.1.2 Physical Security for Media Outside Mission Space

Install all network media (both IP and non-IP) located outside of the mission space in rigid metallic conduit.

3.3.6.2 Physical Security for Devices

Install all devices (computers and controllers) which are located outside of mission space in lockable enclosures. (Recall that per definition of mission space, a room controlled by the mission is mission space regardless of whether it is contiguous with other mission space.)

Install all controllers connected to an IP network in lockable enclosures (both inside and outside of mission space).

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.3.6.3 Physical Security for User Interfaces

Physical security requirements for User Interfaces are specified in the preceding paragraphs of this Section.

3.3.7 Enclosures

Prior to final acceptance of the system, lock all lockable enclosures. Submit an Enclosure Keys submittal with all copies of keys for all enclosures and a key inventory list documenting all keys. Label each key with the matching enclosure identifier.

3.4 USER IDENTIFICATION AND AUTHENTICATION

{For Government Reference Only: This subpart (and its subparts) relates to IA-2, IA-2(1), IA-2(12), IA-5 IA-5(b), IA-5(c), IA-5(e), IA-5(g), IA-5(1), IA-5(11); CCI-000764, CCI-000765, CCI-001953, CCI-001954, CCI-001544, CCI-001989, CCI-000182, CCI-001610, CCI-000192, CCI-000193, CCI-000194, CCI-000205, CCI-001619, CCI-001611, CCI-001612, CCI-001613, CCI-001614, CCI-000195, CCI-001615, CCI-000196, CCI-000197, CCI-000199, CCI-000198, CCI-001616, CCI-001617, CCI-000200, CCI-001618, CCI-002041, CCI-002002, CCI-002003. For MODERATE Impact systems, this subpart also relates to AC-6 (1), AC-6(10), AC-6(2), AC-6(9)-IA-2(4), IA-5(13); CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-000768, CCI-002007.}

This subpart indicates requirements for specific methods of identification and authentication for users and user accounts. Where these requirements conflict apply the following order of precedence: 1) If present, Device Specific Requirements take precedence over any other requirements; and then 2) multifactor authentication requirements take precedence over password requirements.

3.4.1 User Identification and Authentication for All System Types

Unless otherwise indicated, all user interfaces supporting accounts (either FULLY or MINIMALLY) must implement Identification and Authorization via passwords.

For MODERATE Impact Systems: Software running on computers and computer operating systems must manage cached authenticators in accordance with the relevant STIGs. All other devices and software must not use cached authenticators.

3.4.2 User Identification and Authentication for Specific System Types

System specific requirements are in addition to and supersede those indicated for all system types. When no additional requirements are indicated for a specific system type the requirements for all systems still apply to that system type.

3.4.3 User Identification and Authentication for Specific Devices

There are no additional device specific user interface requirements

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.4.4 Implementation of Identification and Authorization Requirements

Identification and Authorization must be met by one of the following methods:

- a. Direct implementation in the user interface.
- b. For user interfaces on a computer: inheriting the Identification and Authorization from the computer operating system, either by the operating system limiting access to specific applications by user, or by the application itself having permissions based on the user logged into the computer.
- c. For remote interfaces: an implementation shared between the remote user interface server and the remote user interface client. For example, a requirement for PIV authentication may be met on a remote user interface by a PIV reader on a web browser client which sends the authentication information via HTTPS to the remote server.

3.4.5 Password-Based Authentication Requirements

3.4.5.1 Passwords for Software and Applications Running on Computers

All software and applications running on computers supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character. The list of supported special characters must include at least 4 separate characters.
- f. Password must have a minimum lifetime of 24 hours.
- g. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- h. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters (where location is significant, a character may be reused if it is in a different position).
- i. Passwords must be cryptographically protected during storage and transmission.

3.4.5.2 Passwords for Controllers FULLY Supporting Accounts

All controllers FULLY supporting accounts and supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character. The list of supported special characters must include at least 4 separate characters.
- f. Password must have a maximum lifetime of sixty (60) days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters.
- h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.3 Passwords for Remote Interfaces

Passwords for connecting to a Remote User Interface supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character. The list of supported special characters must include at least 4 separate characters.
- f. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters (where location is significant, a character may be reused if it is in a different position).
- h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.4 Passwords for Devices Minimally Supporting Accounts

Devices MINIMALLY supporting accounts must support passwords with a minimum length of four characters.

3.4.5.5 Password Configuration and Reporting

For all devices with a password, change the password from the default password. Coordinate selection of passwords with the Password Point of Contact. Do not use the same password for more than one device unless

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

specifically instructed to do so. Provide a Confidential Password Report documenting the password for each device and describing the procedure to change the password for each device.

Do not provide the Password Summary Report in electronic format. Provide two hardcopies of the Password Summary Report, each copy in its own sealed envelope.

3.4.6 Authenticator Feedback

{For Government Reference Only: This subpart relates to IA-6; CCI-000206}

Devices must never show authentication information, including passwords, on a display. Devices that momentarily display a character as it is entered, and then obscure the character, are acceptable. For devices that have STIGs or SRGs related to obscuring of authenticator feedback (CCI-000206), comply with the requirements of those STIGs/SRGs.

3.5 CYBERSECURITY AUDITING

Where an auditing requirement exists for email notification, notify via email the application administrator and Information System Security Officer (ISSO) of the event. Coordinate with the Email Address Point of Contact for email addresses. If outgoing email is not available to the system, disable email notifications.

3.5.1 Audit Events, Content of Audit Records, and Audit Generation

{For Government Reference Only: This subpart (and its subparts) relates to AU-2(a), AU-2(c), AU-2(d), AU-3, AU-10, AU-12, AU-14(b), AU-14(1), AU-14(2), AU-14(3), CM-5(1), SC-7 (9); CCI-000123, CCI-001571, CCI-000125, CCI-001485, CCI-000130, CCI-000131, CCI-000132, CCI-001230, CCI-000133, CCI-000134, CCI-001487, CCI-000166, CCI-001899, CCI-000169, CCI-001459, CCI-000171, CCI-000172, CCI-001910, CCI-001914, CCI-001919, CCI-001464, CCI-001462, CCI-001920, CCI-001814, CCI-002400. For MODERATE Impact systems, this subpart (and its subparts) also relates to AU-3 (1); CCI-000135, CCI-001488}

For devices that have STIG/SRGs related to audit events, content of audit records or audit generation, comply with the requirements of those STIG/SRGs.

If auditing requirements can be met using existing control system alarm or event capabilities, those existing capabilities may be used to meet these requirements.

3.5.1.1 Computers

For each computer, provide the capability to select audited events and the content of audit logs. Configure computers to audit the indicated events, and to record the indicated information for each auditable event. Send logs to a syslog server that is only accessible via accounts on the system with privileged level access.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.5.1.1.1 Audited Events

Configure each computer to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)
- b. Successful and unsuccessful logon attempts
- c. Successful logouts
- d. Privileged activities or other system level access
- e. Concurrent logons from different workstations
- f. Successful and unsuccessful accesses to objects
- g. Program initiations
- h. Direct access to the information system
- i. Account creations, modifications, disabling, and terminations. For MODERATE Impact Systems, also provide email notification when these audit events occur.
- j. Kernel module load, unload, and restart

3.5.1.1.2 Audit Event Information To Record

Configure each computer to record, for each auditable event, the following information (where applicable to the event):

- a. What type of event occurred
- b. When the event occurred
- c. Where the event occurred
- d. The source of the event
- e. The outcome of the event
- f. The identity of any individuals or subjects associated with the event
- g. For MODERATE Impact Systems: For all privileged commands, full-text recording of the executed command and the user executing the command

For MODERATE Impact Systems: Audit records must provide sufficient detail to reconstruct events to determine cause of compromise and magnitude of damage, malfunction, or security violation.

3.5.1.2 Default Requirements for Control System Controllers

For control system controllers where Audit Events, Content of Audit Records, and Audit Generation are not otherwise indicated in this Section:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.5.1.2.1 Controllers Which FULLY Support Accounts

For each controller which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure controllers to audit the indicated events, and to record the indicated information for each auditable event.

3.5.1.2.1.1 Audited Events

Configure each controller to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)
- b. Successful and unsuccessful logon attempts
- c. Successful logouts
- d. Concurrent logons from different workstations
- e. All account creations, modifications, disabling, and terminations. For MODERATE Impact Systems, also provide email notification when these audit events occur.
- f. All kernel module load, unload, and restart
- g. For privileged user interfaces in MODERATE Impact Systems: All user commands.

3.5.1.2.1.2 Audit Event Information To Record

Configure each controller to record, for each auditable event, the following information (where applicable to the event):

- a. what type of event occurred
- b. when the event occurred
- c. where the event occurred
- d. the source of the event
- e. the outcome of the event
- f. the identity of any individuals or subjects associated with the event
- g. For privileged user interfaces in MODERATE Impact Systems: Full text recording of the executed command and the user executing the command.

For MODERATE Impact Systems: Audit records must provide sufficient detail to reconstruct events to determine cause of compromise and magnitude of damage, malfunction, or security violation

3.5.1.2.2 Controllers Which Do Not FULLY Support Accounts

For each controller which does not FULLY support accounts configure the controller to audit all controller shutdown and startup events and to record for each event the type of event and when the event occurred.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.5.2 Audit Time Stamps

{For Government Reference Only: This subpart (and its subparts) relates to AU-8; CCI-000159, CCI-001889, CCI-001890. For MODERATE Impact systems, this subpart (and its subparts) also relates to AU-8 (1); CCI-001891, CCI-001892, CCI-002046.}

Any device (computer or controller) generating audit records must have an internal clock capable of providing time with a resolution of one second. Clocks must not drift more than 10 seconds per day. Configure the system so that each device (computer or controller) generating audit records maintains accurate time to within 1 second. Note that if the control system specifications include requirement for clocks, the most stringent requirement applies.

3.5.3 Auditing Front End Software

The project site currently has the following software to support control system auditing: TBD. If there is no existing auditing front end software or the software is not compatible with the provided control systems, provide Auditing Front End Software with audit log import and upload, export, notification, and analysis functionality. The Auditing Front End Software may be provided as a component of the control system front end or as a separate software package, and a single package may serve multiple control systems provided under the same projects if they are sharing a cybersecurity authorization.

When the Auditing Front End Software is neither existing nor installed under the requirements of another Section, furnish the Auditing Front End Software media and license. Submit copies of Auditing Front End Software if this function is not part of the software provided with the control system to meet requirements of other Sections.

3.5.3.1 Import and Upload Requirements

Auditing Front End Software must be capable of importing audit logs from the Device Audit Record Upload Software and of uploading audit logs over the network from all control system devices supporting network upload of audit logs.

3.5.3.2 Export Requirements

Auditing Front End Software must be capable of exporting to a file format supported by Microsoft Excel.

3.5.3.3 Notification Of Audit Failure in Devices in MODERATE Impact Systems

The auditing front end software must be capable of receiving notifications of audit failure from control system devices and computers and be able to provide email notification based on receipt of the notification.

3.5.3.4 Audit Reduction and Report Generation In MODERATE Impact Systems

{For Government Reference Only: This subpart (and its subparts) relates to AU-6(4), AU-7(a), AU-7(b), AU-7(1), AU-12(1); CCI-000154, CCI-001875, CCI-001876, CCI-001877, CCI-001878, CCI-001879, CCI-001880, CCI-001881, CCI-001882, CCI-000158, CCI-000173, CCI-000174, CCI-001577.}

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Auditing Front End Software must provide audit reduction and reporting capabilities that supports on-demand review and analysis, on demand reporting, and after the fact investigations of security incidents. The software must be able to combine audit records from all components within the system and analyze them as a single audit record. The software must correct for discrepancies in timestamps of audit logs from different sources and be able to account for discrepancies up to 2 seconds between time ordering of audit records. The software must have the capability to filter audit records using user-defined fields within the audit records.

The audit reduction and reporting capabilities may incorporate third party application, such as Excel or Access.

3.5.4 Audit Storage Capacity and Audit Upload

{For Government Reference Only: This subpart (and its subparts) relates to AU-4; CCI-001848, CCI-001849}

The creation of audit records must never interfere with normal device operation. Devices must cease collection of auditing information if required to maintain normal operation.

- a. For devices that have STIG/SRGs related to audit storage capacity (CCI-001848 or CCI-001849) comply with the requirements of those STIG/SRGs.
- b. For controllers capable of generating audit records, provide 60 days worth of secure local storage, assuming 10 auditable events per day.
- c. For computers, provide storage in conformance with applicable STIGs/SRGs.

3.5.4.1 Audit Log Storage Notification In MODERATE Impact Systems

{For Government Reference Only: This subpart (and its subparts) relates to AU-5(1); CCI-001855.}

Controllers storing audit logs must provide notification when audit logs reach 75 percent of capacity either directly through email or indirectly by sending a notification to a computer, and the computer sending an email. Computers storing audit logs must provide notification when audit logs reach 75 percent of capacity directly through email.

3.5.4.2 Device Audit Record Upload Software

For each device (computer or controller) required to audit events and for which audit logs cannot be uploaded over the network by the Auditing Front End Software, provide and license to the Government software implementing a secure mechanism of uploading audit records from the device and exporting them to the Auditing Front End Software. Where different devices use different software, provide software of each type required to upload audit logs from all devices.

Submit copies of device audit record upload software if this function is not part of the software provided with the control system to meet requirements of other Sections. If there are no devices requiring this software, provide a document stating this in lieu of this submittal.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.5.5 Response to Audit Processing Failures

{For Government Reference Only: This subpart (and its subparts) relates to AU-5; CCI-000139, CCI-000140, CCI-001490.}

In the case of a failure in the auditing system, computers associated with auditing must provide email notification. For MODERATE Impact systems, the computer must also notify the associated auditing front end software. In case of an audit failure, if possible, continue to collect audit records by overwriting existing audit records.

For MODERATE Impact Systems: In the case of an audit failure at a controller performing auditing, the device must notify the associated auditing front end software of the audit failure if able, and must continue to collect audit records by overwriting existing audit records if able. The auditing front end software must provide notification as indicated, treating the notification of failure from the device as a failure in the auditing system.

3.6 REQUIREMENTS FOR LEAST FUNCTIONALITY

{For Government Reference Only: This subpart (and its subparts), along with the Network Communication, Ports, Protocols and Services Report submittal specified elsewhere in this section, relates to CM-6(a), CM-6(c), CM-7, CM-7(1)(b), SC-41; CCI-000363, CCI-000364, CCI-000365, CCI-001588, CCI-001755, CCI-000381, CCI-000380, CCI-000382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546. For MODERATE Impact systems, this subpart (and its subparts) also relates to CM-7(2), CM-7(5)(a), CM-7(5)(b); CCI-000381, CCI-000380, CCI-000382, CCI-001761, CCI-001762}

For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I/O access for least functionality), install and configure the device in accordance with that STIG or SRGs.

3.6.1 Device Capabilities

For LOW Impact Systems: Do not provide devices with remote user interfaces or with full user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

For MODERATE Impact Systems: Do not provide devices with remote user interfaces or full user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

For all MODERATE Impact Systems: Unless specifically required by the government, do not provide a capability to update device firmware over the network.

3.6.2 Software

For software that has a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port access for least functionality), install and configure the software in accordance with that STIG or SRG.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Do not install software that is not specifically required to meet a contract requirement. Remove any previously installed that is not specifically required to meet a contract requirement. Do not implement functionality within software that is not specifically required to meet contract requirements.

3.7 SYSTEM AND COMMUNICATION PROTECTION

3.7.1 Collaborative Computing

{For Government Reference Only: This subpart relates to SC-15(a), SC-15(b); CCI-001150, CCI-001152.}

Without explicit approval from the project site, control systems must not use collaborative computing technologies.

3.7.2 Denial of Service Protection and Application Partitioning In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to SC-5, SC-12, SC-7(a); CCI-001093, CCI-002385, CCI-002386, CCI-002430, CCI-001097. For MODERATE Impact systems, this subpart also relates to SC-2; CCI-001082.}

To the greatest extent practical, implement control logic without reliance on the network. Except when required to meet the requirements of the control system Section (where the requirement can only be met using computer hardware), do not implement control logic in computers. For MODERATE Impact systems, do not implement control logic in a device providing (i.e. acting as a server for) a Full Remote User Interface.

3.7.3 Mobile Code In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to SC-18(a), SC-18(b), SC-18(c), SC-18(1), SC-18(3), SC-18(4); CCI-001160, CCI-001161, CCI-001162, CCI-001163, CCI-001164, CCI-001165, CCI-001166, CCI-001662, CCI-002457, CCI-002458, CCI-001169, CCI-001695, CCI-001170, CCI-002469}

Devices with STIGs/SRGs related to Mobile Code and to Security Control SC-18 must be installed in accordance with the relevant STIGs/SRGs. All remote user interfaces must meet the requirements of the "Web Browsers and Application SRG".

Mobile code may only be downloaded from a specifically authorized mobile code repository. Coordinate with the Mobile Code Point of Contact for the location of a repository.

3.7.4 Protection of Information at Rest In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to SC-28, SC-28(1); CCI-001199, CCI-002472, CCI-002475, CCI-002476}

Computers must protect information at rest in accordance with applicable STIGs.

Any control system device storing personally identifiable information (PII), controlled unclassified information (CUI), or classified information must be protected by an Information At Rest encryption solution or by a physical security solution. Provide a Protection of

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Information At Rest Proposal indicating each device storing PII, CUI, or classified information and the encryption or physical security solution proposed for that device for government approval. If no devices stores PII, CUI, or classified information, provide a document stating this as the Protection of Information At Rest Proposal submittal. Do proceed with device selection and installation until the Protection of Information At Rest Proposal is approved. Once approved, implement approved Information At Rest protections.

3.8 SAFE MODE AND FAIL SAFE OPERATION

{For Government Reference Only: This subpart (and its subparts) relates to CP-12, SI-10(3), SI-17; CCI-002855, CCI-002856, CCI-002857, CCI-002754, CCI-002773, CCI-002774, CCI-002775}

For all control system components with an applicable STIG or SRG, configure the component in accordance with all applicable STIGs and SRGs.

3.9 SYSTEM MAINTENANCE TOOL SOFTWARE

{For Government Reference Only: This subpart (and its subparts) relates to MA-3; CCI-000865.}

Submit and license to the Government all software required to operate, maintain and modify the control system such 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. Submit hard copies of user manuals for each software with the software submittal. Provide any hardware keys or dongles, software keys, license numbers, and other information required to enable the Government to access or change the system.

For software provided and licensed to the Government under the requirements of another Section, submit a statement indicating the Section and Submittal under which the software was provided. For software provided to meet the requirements of this Section and not provided and licensed under another Section, submit software and software user manuals on DVD or CD as a Technical Data Package and submit one hard copy of the software user manual for each piece of software.

3.10 DEVICE POWER

{For Government Reference Only: This subpart (and its subparts) relates to PE-11, PE-11(1); CCI-002955, CCI-000961. For MODERATE Impact systems, this subpart (and its subparts) also relates to PE-9, PE-9(1); CCI-000952, CCI-002953, CCI-002954.}

For LOW Impact Systems: Provide emergency power in accordance with the control system and equipment specification Sections.

For MODERATE Impact Systems: Provide control system with power supply meeting or exceeding the reliability of the controlled equipment. Powering control system devices using the same power source as the equipment controlled by the device is a permissible method of meeting this requirement. Without explicit approval from the government, do not install local uninterruptible power supplies (UPSes) as a source of device power.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.10.1 Device Behavior on Loss of Power In MODERATE Impact Systems:

Application programs and configuration settings must be stored in devices in manner such that a loss of power does not result in a loss of the application program or configuration settings: Loss of power must never result in the loss of application programs, regardless of the length of time power is lost; and loss of power for less than 2,500 hours must not result in the loss of configured settings.

In the event of a loss of power, when power is restored, controllers and computers executing control logic (and the underlying equipment) must recover and resume their normal sequences of operation. Note that the sequence of operation may require specific actions (e.g. startup sequences) upon recovery from loss of power.

3.11 VULNERABILITY SCANNING

{For Government Reference Only: This subpart (and its subparts) relates to RA-5 RA-5(a), RA-5(b), RA-5(c), RA-5(d); CCI-001054, CCI-001055, CCI-000156, CCI-001641, CCI-001643, CCI-001057, CCI-001058, CCI-001059. For MODERATE Impact systems, this subpart (and its subparts) also relates to RA-5(1), RA-5(5); CCI-001062, CCI-001067, CCI-001645, CCI-002906.}

All IP devices must be scannable, such that the device can be scanned by industry standard IP network scanning utilities without harm to the device, application, or functionality.

3.11.1 Computers and Software Running on Computers

Computers and applications running on computers must meet relevant vulnerability scanning STIGs/SRGs and respond to approved DoD vulnerability scanning tools.

3.11.2 Controllers

Provide controllers that are scannable by standard control system discovery tools or control system browsers and return meaningful status information including the network inputs and outputs for the controller. This information must contain sufficient detail to detect vulnerabilities or exploits of the controller.

Provide all software needed to scan the control system as the Control System Scanning Tools submittal. If the software required to scan the system is already installed at the project site or is provided under a separate section instead provide a statement indicating this.

3.12 FIPS 201-2 REQUIREMENT

{For Government Reference Only: This subpart (and its subparts) relates to SA-4 (10); CCI-003116}

Devices in the following systems which implement PIV must be on the NIST FIPS 201-2 approved product list (<https://www.idmanagement.gov/approved-products-list/>): NONE.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.13 SYSTEM AND INTEGRATION INTEGRITY

3.13.1 Malicious Code Protection

{For Government Reference Only: This subpart (and its subparts) relates to SI-3(c); CCI-001241, CCI-002623}

For all computers installed under this project, provide malware protection software media, provide licenses, and install and configure malware protection software as indicated. Coordinate with the Government Computer Access Point of Contact as required.

- a. Provide malware protection software licenses.
- b. Provide malware protection software media.
- c. Install and configure malware protection software in accordance with the relevant STIGs.

3.13.2 Software, Firmware, and Information Integrity In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to CM-5(3); CCI-001749, CCI-002704, CCI-002726}

If there exists Integrity Verification Software that can check boot process, software, firmware, or information in the control system and verify its integrity, provide it. If no such software exists, provide a statement to this affect in lieu of the software.

3.14 CONTROL SYSTEM CYBERSECURITY TESTING

{For Government Reference Only: For MODERATE Impact systems, this subpart (and its subparts) relates to SA-11(a), SA-11(b), SA-11(c), SA-11(d), SA-11(e); CCI-003171, CCI-003172, CCI-003173, CCI-003174, CCI-003175, CCI-003176, CCI-003177, CCI-003178.}

3.14.1 Control System Cybersecurity Testing Procedures

Prepare and submit Control System Cybersecurity Testing Procedures explaining step-by-step, the actions and expected results that will demonstrate that the control system meets the requirements of this Section. The Control System Cybersecurity Testing Procedures may be submitted as a Technical Data Package.

3.14.2 Control System Cybersecurity Testing Execution

Using the Control System Cybersecurity Testing Procedures verify that the control system meets the requirements of this Section. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. If testing reveals deficiencies in the system, correct the deficiency and retest until successful.

3.14.3 Control System Cybersecurity Testing Report

Prepare and submit a Control System Cybersecurity Testing Report documenting all tests performed and their results. Include all tests in

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

the Control System Cybersecurity Testing Procedures and any additional tests performed during testing. Document test failures and repairs conducted with the test results. The Control System Cybersecurity Testing Report may be submitted as a Technical Data Package

3.15 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT

In addition to testing and testing support required by other Sections, provide a minimum of 40 hours of technical support for cybersecurity testing of control systems to support the DoD Risk Management Framework process Cybersecurity assessment of the control system. This support is independent of (and in addition to) the Control System Cybersecurity Testing specified in this section.

3.16 CYBERSECURITY TRAINING

Provide eight hours of classroom and hands-on training for six Government personnel on the cybersecurity operation and maintenance of the control system provided. This training is in addition to and must be coordinated with control system training specified in other Sections.

The Government will provide the training location. Training must cover, at a minimum: (a) applying software and firmware updates, (b) user account creation, modification and deletion, (c) audit log upload procedures and (d) identification of privileged user interfaces and system impact of those interfaces. Training session must include a question and answer period during which government staff questions about cybersecurity aspects of the control system are answered.

-- End of Section --

SEARCH INDEX	Control Number	800-53 Control Text Indicator	CCI	CCI Definition	Implementation Guidance	Assessment Procedures	CURRENT UFC 4-010-06 (26 NOVEMBER 2019) INFORMATION										Combined Category	UFGS REFERENCE
							Applicable to a Control System?	DoD-Defined	Enclave	Designer	Non-Designer	Impractical	Removed From Low	N/A Justification	REM Justification			
2145	SC-7	SC-7(c)	CCI-001098	The information system connects to external networks or information systems only through managed interfaces consisting of boundary protection devices arranged in accordance with an organizational security architecture.	The organization being inspected/assessed designs the information system to enforce requirements that components connect to external networks or information systems only through managed interfaces consisting of boundary protection devices arranged in accordance with an organizational security architecture.	The organization conducting the inspection/assessment obtains and examines network topology diagrams, architecture documentation, or any other documentation identifying component connectivity to ensure the organization being inspected/assessed connects to external networks or information systems only through managed interfaces consisting of boundary protection devices arranged in accordance with an organizational security architecture.	TRUE		X								Enclave	3.7.5 Process Isolation and Boundary Prot...
2203	SC-12	SC-12	CCI-002430	The organization defines the requirements for cryptographic key storage to be employed within the information system.	DoD has defined the requirements for key storage as requirements for key storage defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the requirements for key storage as requirements for key storage defined in DoDI 8520.02 "Public Key Infrastructure and Public Key	TRUE	X	X			X					DoD-Defined Enclave Impractical	3.7.2 Denial of Service Protection<TAI OP...
2225	SC-15	SC-15(a)	CCI-001150	The information system prohibits remote activation of collaborative computing devices excluding the organization-defined exceptions where remote activation is to be allowed.	The organization being inspected/assessed configures the information system to prohibit remote activation of collaborative computing devices excluding dedicated VTC suites located in approved VTC locations that are centrally managed.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to prohibit remote activation of collaborative computing devices excluding dedicated VTC suites located in approved VTC locations that are centrally managed.	TRUE		X			X					Enclave Impractical	3.7.1 Collaborative Computing
2227	SC-15	SC-15(b)	CCI-001152	The information system provides an explicit indication of use to users physically present at collaborative computing devices.	The organization being inspected/assessed configures the information system to provide an explicit indication of use to users physically present at collaborative computing devices. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1152.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to provide an explicit indication of use to users physically present at collaborative computing devices. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1152.	TRUE		X			X					Enclave Impractical	3.7.1 Collaborative Computing
2422	SI-2	SI-2(a)	CCI-001227	The organization corrects information system flaws.	The organization being inspected/assessed corrects information system flaws within the time period directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs). The organization documents the corrections on their POA&M. DoD has defined the time period as within the time period directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	The organization conducting the inspection/assessment obtains and examines the information system POA&M and examines the information system to ensure the organization being inspected/assessed corrects information system flaws.	TRUE		X		X	X					Enclave Non-Designer Impractical	1.10 SOFTWARE LICENSING
2423	SI-2	SI-2(c)	CCI-002605	The organization installs security-relevant software updates within organization-defined time period of the release of the updates	The organization being inspected/assessed configures the information system to install security-relevant software updates within 30 days of the release of the updates	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to install security-relevant software updates within 30 days of the release of the updates.	TRUE				X						Non-Designer	1.10 SOFTWARE LICENSING
1	AC-1	AC-1(a)	CCI-002107	The organization defines the personnel or roles to be recipients of the access control policy necessary to facilitate the implementation of the access control policy and associated access controls.	DoD has defined the personnel or roles as all personnel.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as all personnel.	TRUE	X				X	X				DoD-Defined Non-Designer Impractical	---
2	AC-1	AC-1(a)	CCI-002108	The organization defines the personnel or roles to be recipients of the procedures necessary to facilitate the implementation of the access control policy and associated access controls.	DoD has defined the personnel or roles as all personnel.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as all personnel.	TRUE	X				X	X				DoD-Defined Non-Designer Impractical	---
3	AC-1	AC-1(a)(1)	CCI-000001	The organization develops and documents an access control policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	The organization being inspected/assessed develops and documents an access control policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	The organization conducting the inspection/assessment obtains and examines the access control policy to ensure the organization being inspected/assessed develops and documents an access control policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	TRUE					X					Non-Designer	---
4	AC-1	AC-1(a)(1)	CCI-000002	The organization disseminates the access control policy to organization-defined personnel or roles.	The organization being inspected/assessed disseminates via an information sharing capability to all personnel.	The organization conducting the inspection/assessment examines the access control policy via the organization's information sharing capability to ensure the organization being inspected/assessed disseminates the policy to all personnel.	TRUE					X					Non-Designer	---
5	AC-1	AC-1(a)(2)	CCI-000004	The organization develops and documents procedures to facilitate the implementation of the access control policy and associated access controls.	The organization being inspected/assessed develops and documents procedures to facilitate the implementation of the access control policy and associated access controls.	The organization conducting the inspection/assessment obtains and examines the procedures to facilitate the implementation of the access control policy and associated access controls to ensure the organization being inspected/assessed develops and documents procedures to facilitate the implementation of the access control policy and associated access controls.	TRUE					X					Non-Designer	---

6	AC-1	AC-1(a)(2)	CCI-000005	The organization disseminates the procedures to facilitate access control policy and associated access controls to the organization-defined personnel or roles .	The organization being inspected/assessed disseminates via an information sharing capability to all personnel the procedures to facilitate access control policy and associated access controls. DoD has defined the personnel or roles as all personnel.	The organization conducting the inspection/assessment examines the procedures to facilitate access control policy and associated access controls via the organization's information sharing capability to ensure the organization being inspected/assessed disseminates the procedures to all personnel. DoD has defined the personnel or roles as all personnel.	TRUE				X						Non-Designer	---
7	AC-1	AC-1(b)(1)	CCI-001545	The organization defines a frequency for reviewing and updating the access control policy.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as annually.	TRUE	X									DoD-Defined	---
8	AC-1	AC-1(b)(1)	CCI-000003	The organization reviews and updates the access control policy in accordance with organization-defined frequency.	The organization being inspected/assessed annually reviews and updates the access control policy. The organization must maintain review and update	The organization conducting the inspection/assessment obtains and examines the audit trail of reviews and updates to ensure the organization being inspected/assessed annually reviews and updates the access control policy.	TRUE				X						Non-Designer	---
9	AC-1	AC-1(b)(2)	CCI-001546	The organization defines a frequency for reviewing and updating the access control procedures.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as annually.	TRUE	X									DoD-Defined	---
10	AC-1	AC-1(b)(2)	CCI-000006	The organization reviews and updates the access control procedures in accordance with organization-defined frequency.	The organization being inspected/assessed annually reviews and updates the access control procedures. The organization must maintain review and update activity as an audit trail.	The organization conducting the inspection/assessment obtains and examines the audit trail of reviews and updates to ensure the organization being inspected/assessed annually reviews and updates the access control procedures. DoD has defined the frequency as annually.	TRUE				X						Non-Designer	---
12	AC-2	AC-2(a)	CCI-002111	The organization identifies and selects the organization-defined information system account types of information system accounts which support organizational missions/business functions.	The account types are defined per AC-2, CCI 2110.	The organization conducting the inspection/assessment obtains and examines the account types are defined per AC-2, CCI 2110.	TRUE				X						Non-Designer	---
13	AC-2	AC-2(b)	CCI-002112	The organization assigns account managers for information system accounts.	The organization being inspected/assessed documents personnel responsible for the management of system accounts.	The organization conducting the inspection/assessment obtains and examines the documented appointment of management personnel to ensure that the organization being inspected/assessed has documented personnel responsible for the management of system accounts.	TRUE				X						Non-Designer	---
14	AC-2	AC-2(c)	CCI-000008	The organization establishes conditions for group membership.	The organization being inspected/assessed documents conditions for adding accounts as members of groups.	The organization conducting the inspection/assessment obtains and examines the documented conditions for adding accounts as members of groups to ensure that the conditions are established.	TRUE				X						Non-Designer	---
15	AC-2	AC-2(c)	CCI-002113	The organization establishes conditions for role membership.	The organization being inspected/assessed documents conditions for adding accounts as members of roles.	The organization conducting the inspection/assessment obtains and examines the documented conditions for adding accounts as members of roles to ensure that the conditions are established.	TRUE				X						Non-Designer	---
16	AC-2	AC-2(d)	CCI-002115	The organization specifies authorized users of the information system.	The organization being inspected/assessed documents authorized users of the information system.	The organization conducting the inspection/assessment obtains and examines the documented list of authorized users for a sampling of information system accounts to ensure that the authorized users are specified.	TRUE				X						Non-Designer	---
17	AC-2	AC-2(d)	CCI-002116	The organization specifies authorized group membership on the information system.	The organization being inspected/assessed documents authorized group membership on the information system.	The organization conducting the inspection/assessment obtains and examines the documented list of authorized groups for a sampling of information system accounts to ensure that the authorized groups are specified.	TRUE				X						Non-Designer	---
18	AC-2	AC-2(d)	CCI-002117	The organization specifies authorized role membership on the information system.	The organization being inspected/assessed documents authorized role membership on the information system.	The organization conducting the inspection/assessment obtains and examines the documented list of authorized roles for a sampling of information system accounts to ensure that the authorized roles are specified	TRUE				X						Non-Designer	---
19	AC-2	AC-2(d)	CCI-002118	The organization specifies access authorizations (i.e., privileges) for each account on the information system.	The organization being inspected/assessed documents access authorizations (i.e., privileges) for each account on the information system.	The organization conducting the inspection/assessment obtains and examines the documented list of access authorizations for a sampling of information system accounts to ensure that the access authorizations are specified.	TRUE				X						Non-Designer	---
20	AC-2	AC-2(d)	CCI-002119	The organization specifies other attributes for each account on the information system.	The organization being inspected/assessed documents other attributes for each account on the information system.	The organization conducting the inspection/assessment obtains and examines the documented list of other attributes for a sampling of information system accounts to ensure that other attributes are specified.	TRUE				X						Non-Designer	---
21	AC-2	AC-2(e)	CCI-002120	The organization defines the personnel or roles authorized to approve the creation of information system accounts.	DoD has defined the personnel or roles as the ISSM or ISSO.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X			X	X					DoD-Defined Non-Designer Impractical	---
22	AC-2	AC-2(e)	CCI-000010	The organization requires approvals by organization-defined personnel or roles for requests to create information system accounts.	The organization being inspected/assessed implements a process for the ISSM or ISSO to approve information system account requests.	The organization conducting the inspection/assessment obtains and examines the audit trail of approvals to ensure that the organization being inspected/assessed implements a process for the ISSM or ISSO to approve information system account requests.	TRUE				X						Non-Designer	---
23	AC-2	AC-2(f)	CCI-002121	The organization defines the procedures or conditions to be employed when creating, enabling, modifying, disabling, and removing information system accounts.	The organization being inspected/assessed defines and documents the procedures or conditions to be employed when creating, enabling, modifying, disabling, and removing information system accounts.	The organization conducting the inspection/assessment obtains and examines the documented procedures or conditions to ensure the organization being inspected/assessed defines the procedures or conditions to be employed when creating, enabling, modifying, disabling, and removing information	TRUE				X						Non-Designer	---
24	AC-2	AC-2(f)	CCI-000011	The organization creates, enables, modifies, disables, and removes information system accounts in accordance with organization-defined procedures or conditions.	The organization being inspected/assessed implements account maintenance processes to create, enable, modify, disable, and remove information system accounts in accordance with procedures or conditions	The organization conducting the inspection/assessment obtains and examines the audit trail of account maintenance activities to ensure the organization being inspected/assessed implements account maintenance processes to create, enable, modify, disable, remove, and track information system	TRUE				X						Non-Designer	---
25	AC-2	AC-2(g)	CCI-002122	The organization monitors the use of information system accounts.	The organization being inspected/assessed implements a process to monitor the use of information system accounts.	The organization conducting the inspection/assessment obtains and examines the audit trail to ensure that the organization being inspected/assessed implements a process to monitor the use of information system accounts.	TRUE				X						Non-Designer	---
26	AC-2	AC-2(h)(1)	CCI-002123	The organization notifies account managers when accounts are no longer required.	The organization being inspected/assessed implements a process to notify account managers when accounts are no longer required.	The organization conducting the inspection/assessment obtains and examines the audit trail of notifications to ensure the organization being inspected/assessed implements a process to notify account managers when	TRUE				X						Non-Designer	---
27	AC-2	AC-2(h)(2)	CCI-002124	The organization notifies account managers when users are terminated or transferred.	The organization being inspected/assessed implements a process to notify account managers when users are terminated or transferred.	The organization conducting the inspection/assessment obtains and examines the audit trail of notifications to ensure the organization being inspected/assessed implements a process to notify account managers when users are terminated or transferred.	TRUE				X						Non-Designer	---
28	AC-2	AC-2(h)(3)	CCI-002125	The organization notifies account managers when individual information system usage or need-to-know changes.	The organization being inspected/assessed implements a process to notify account managers when individual information system usage or need-to-know changes. The organization being inspected/assessed maintains an audit trail of notifications.	The organization conducting the inspection/assessment obtains and examines the audit trail of notifications to ensure the organization being inspected/assessed implements a process to notify account managers when individual information system usage or need-to-know changes.	TRUE				X						Non-Designer	---

29	AC-2	AC-2(i)(1)	CCI-002126	The organization authorizes access to the information system based on a valid access authorization.	The organization being inspected/assessed authorizes access to the information system based on the access authorization process. The organization being inspected/assessed maintains an audit trail of approved access.	The organization conducting the inspection/assessment obtains and examines the audit trail of approved access to ensure the organization being inspected/assessed authorizes access to the information system based on the access authorization process.	TRUE				X					Non-Designer	---
30	AC-2	AC-2(i)(2)	CCI-002127	The organization authorizes access to the information system based on intended system usage.	The organization being inspected/assessed authorizes access to the information system based on intended system usage. The organization being inspected/assessed maintains an audit trail of approved access.	The organization conducting the inspection/assessment obtains and examines the audit trail of approved access to ensure the organization being inspected/assessed authorizes access to the information system based on intended system usage.	TRUE				X					Non-Designer	---
31	AC-2	AC-2(i)(3)	CCI-002128	The organization authorizes access to the information system based on other attributes as required by the organization or associated missions/business functions.	The organization being inspected/assessed authorizes access to the information system based on other attributes as required by the organization or associated missions/business functions.	The organization conducting the inspection/assessment obtains and examines the audit trail of approved access to ensure the organization being inspected/assessed authorizes access to the information system based on other attributes as required by the organization or associated	TRUE				X					Non-Designer	---
32	AC-2	AC-2(j)	CCI-000012	The organization reviews information system accounts for compliance with account management requirements per organization-defined frequency.	The organization being inspected/assessed implements a process to review information system accounts for compliance with account management requirements at a minimum, annually. The organization being inspected/assessed maintains	The organization conducting the inspection/assessment obtains and examines the audit trail of reviews to ensure the organization being inspected/assessed implements a process to review information system accounts for compliance with account management requirements at a minimum, annually. DoD has defined the frequency as at a minimum, annually.	TRUE				X					Non-Designer	---
33	AC-2	AC-2(j)	CCI-001547	The organization defines the frequency on which it will review information system accounts for compliance with account management requirements.	DoD has defined the frequency as at a minimum, annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as at a minimum, annually.	TRUE	X								DoD-Defined	---
34	AC-2	AC-2(k)	CCI-002129	The organization establishes a process for reissuing shared/group account credentials (if deployed) when individuals are removed from the group.	The organization being inspected/assessed includes in the account management procedures a process for reissuing shared/group account credentials (if deployed) when individuals are removed from the group.	The organization conducting the inspection/assessment obtains and examines the account management procedures to ensure the organization being inspected/assessed includes in the account management procedures a process for reissuing shared/group account credentials (if deployed) when individuals are removed from the group.	TRUE				X					Non-Designer	---
215	AC-8	AC-8(c)(1)	CCI-001384	The information system, for publicly accessible systems, displays system use information organization-defined conditions before granting further access.	The organization being inspected/assessed configures the information system to display the content of DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems - Standard Consent Banner and User Agreement," March 2013 before granting further access for publicly accessible systems	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to display the content of DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems - Standard Consent Banner and User Agreement," March 2013 before granting further access for publicly accessible systems	FALSE						X			0	---
216	AC-8	AC-8(c)(2)	CCI-001385	The information system, for publicly accessible systems, displays references, if any, to monitoring that are consistent with privacy accommodations for such systems that generally prohibit those activities.	The organization being inspected/assessed configures the information system to display references, if any, to monitoring that are consistent with privacy accommodations for such systems that generally prohibit those activities for publicly accessible systems.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to display references, if any, to monitoring that are consistent with privacy accommodations for such systems that generally prohibit those activities for publicly accessible systems.	FALSE						X			0	---
217	AC-8	AC-8(c)(2)	CCI-001386	The information system for publicly accessible systems displays references, if any, to recording that are consistent with privacy accommodations for such systems that generally prohibit those activities.	The organization being inspected/assessed configures the information system to display references, if any, to recording that are consistent with privacy accommodations for such systems that generally prohibit those activities for publicly accessible systems. For information system components that have	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to display references, if any, to recording that are consistent with privacy accommodations for such systems that generally prohibit those activities for publicly accessible systems. For information system components that have applicable STIGs or SRGs, the	FALSE						X			0	---
218	AC-8	AC-8(c)(2)	CCI-001387	The information system for publicly accessible systems displays references, if any, to auditing that are consistent with privacy accommodations for such systems that generally prohibit those activities.	The organization being inspected/assessed configures the information system to display references, if any, to auditing that are consistent with privacy accommodations for such systems that generally prohibit those activities for publicly accessible systems. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1387.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to display references, if any, to auditing that are consistent with privacy accommodations for such systems that generally prohibit those activities for publicly accessible systems. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs.	FALSE						X			0	---
219	AC-8	AC-8(c)(3)	CCI-001388	The information system, for publicly accessible systems, includes a description of the authorized uses of the system.	The organization being inspected/assessed configures the information system to include a description of the authorized uses of the system for publicly accessible systems.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to include a description of the authorized uses of the system for publicly accessible systems.	FALSE						X			0	---
307	AC-17	AC-17(a)	CCI-000063	The organization defines allowed methods of remote access to the information system.	The organization being inspected/assessed defines and documents the allowed methods of remote access to the information system. The methods should be defined IAW ports, protocols,	The organization conducting the inspection/assessment obtains and examines the documented methods to ensure the organization being inspected/assessed defines allowed methods of remote access to the information system. DoD has determined the allowed methods of remote access are not	TRUE		X		X					Enclave Non-Designer	---
308	AC-17	AC-17(a)	CCI-002310	The organization establishes and documents usage restrictions for each type of remote access allowed.	The organization being inspected/assessed establishes and documents usage restrictions for each type of remote access allowed.	The organization conducting the inspection/assessment obtains and examines the documented usage restrictions to ensure the organization being inspected/assessed establishes and documents usage restrictions for each type of remote access allowed.	TRUE		X		X					Enclave Non-Designer	---
309	AC-17	AC-17(a)	CCI-002311	The organization establishes and documents configuration/connection requirements for each type of remote access allowed.	The organization being inspected/assessed establishes and documents configuration/connection requirements for each type of remote access allowed.	The organization conducting the inspection/assessment obtains and examines the documented requirements to ensure the organization being inspected/assessed establishes and documents configuration/connection requirements for each type of remote access allowed.	TRUE		X		X					Enclave Non-Designer	---
310	AC-17	AC-17(a)	CCI-002312	The organization establishes and documents implementation guidance for each type of remote access allowed.	The organization being inspected/assessed establishes and documents implementation guidance for each type of remote access allowed.	The organization conducting the inspection/assessment obtains and examines the documented implementation guidance to ensure the organization being inspected/assessed establishes and documents implementation guidance for each type of remote access allowed.	TRUE		X		X					Enclave Non-Designer	---
311	AC-17	AC-17(b)	CCI-000065	The organization authorizes remote access to the information system prior to allowing such connections	The organization being inspected/assessed authorizes remote access to the information system prior to allowing such connections. The organization must maintain an audit trail of authorizations.	The organization conducting the inspection/assessment obtains and examines the audit trail of authorizations to ensure the organization being inspected/assessed authorizes remote access to the information system prior to allowing such connections.	TRUE		X		X					Enclave Non-Designer	---

337	AC-19	AC-19(a)	CCI-000082	The organization establishes usage restrictions for organization controlled mobile devices.	The organization being inspected/assessed establishes and documents usage restrictions for organization controlled mobile devices.	The organization conducting the inspection/assessment obtains and examines the documented usage restrictions to ensure the organization being inspected/assessed establishes usage restrictions for organization controlled mobile devices.	TRUE		X		X						Enclave Non-Designer	---
338	AC-19	AC-19(a)	CCI-002325	The organization establishes configuration requirements for organization controlled mobile devices.	DoD is automatically compliant with this CCI because existing STIGs establish configuration requirements for approved mobile devices.	DoD is automatically compliant with this CCI because existing STIGs establish configuration requirements for approved mobile devices.	TRUE	X	X								DoD-Defined Enclave	---
339	AC-19	AC-19(a)	CCI-002326	The organization establishes connection requirements for organization controlled mobile devices.	The organization being inspected/assessed establishes and documents connection requirements for organization controlled mobile devices.	The organization conducting the inspection/assessment obtains and examines the documented connection requirements to ensure the organization being inspected/assessed establishes connection requirements for organization controlled mobile devices.	TRUE		X		X						Enclave Non-Designer	---
340	AC-19	AC-19(a)	CCI-000083	The organization establishes implementation guidance for organization controlled mobile devices.	The organization being inspected/assessed establishes and documents implementation guidance for organization controlled mobile devices.	The organization conducting the inspection/assessment obtains and examines the documented implementation guidance to ensure the organization being inspected/assessed establishes implementation guidance for organization controlled mobile devices.	TRUE		X		X						Enclave Non-Designer	---
341	AC-19	AC-19(b)	CCI-000084	The organization authorizes connection of mobile devices to organizational information systems.	The organization being inspected/assessed authorizes connection of mobile devices to organizational information systems. The organization must maintain an audit trail of authorizations.	The organization conducting the inspection/assessment obtains and examines the audit trail of authorizations to ensure the organization being inspected/assessed authorizes connection of mobile devices to organizational information systems.	TRUE		X		X						Enclave Non-Designer	---
354	AC-20	AC-10(b)	CCI-002332	The organization establishes terms and conditions, consistent with any trust relationships established with other organizations owning, operating, and/or maintaining external information systems, allowing authorized individuals to process, store or transmit organization-	The organization being inspected/assessed establishes and documents the terms and conditions, consistent with any trust relationships established with other organizations owning, operating, and/or maintaining external information systems, allowing authorized individuals to process, store or transmit organization-	The organization conducting the inspection/assessment obtains and examines the documented terms and conditions to ensure the organization being inspected/assessed establishes terms and conditions, consistent with any trust relationships established with other organizations owning, operating, and/or maintaining external information systems, allowing authorized individuals to process, store or transmit organization-	TRUE				X						Non-Designer	---
355	AC-20	AC-20(a)	CCI-000093	The organization establishes terms and conditions, consistent with any trust relationships established with other organizations owning, operating, and/or maintaining external information systems, allowing authorized individuals to access the information system from the external information systems.	The organization being inspected/assessed establishes and documents terms and conditions, consistent with any trust relationships established with other organizations owning, operating, and/or maintaining external information systems, allowing authorized individuals to access the information system from the external information systems.	The organization conducting the inspection/assessment obtains and examines the documented terms and conditions to ensure the organization being inspected/assessed establishes terms and conditions, consistent with any trust relationships established with other organizations owning, operating, and/or maintaining external information systems, allowing authorized individuals to access the information system from the external information systems.	TRUE		X		X						Enclave Non-Designer	---
365	AC-21	AC-21(a)	CCI-000098	The organization facilitates information sharing by enabling authorized users to determine whether access authorizations assigned to the sharing partner match the access restrictions on the information for organization-defined information circumstances where user discretion is required.	The organization being inspected/assessed documents and implements a process to determine whether access authorizations assigned to the sharing partner match the access restrictions on the information for information circumstances defined in AC-21, CCI 1470 where user discretion is required.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed determines whether access authorizations assigned to the sharing partner match the access restrictions on the information for information circumstances defined in AC-21, CCI 1470 where user discretion is required.	TRUE		X		X						Enclave Non-Designer	---
366	AC-21	AC-21(a)	CCI-001470	The organization defines information sharing circumstances where user discretion is required.	The organization being inspected/assessed defines and documents information sharing circumstances where user discretion is required. DoD has determined the information sharing	The organization conducting the inspection/assessment obtains and examines the documented information sharing circumstances to ensure the organization being inspected/assessed defines information sharing circumstances where user discretion is required.	TRUE		X		X						Enclave Non-Designer	---
367	AC-21	AC-21(b)	CCI-001471	The organization employs organization-defined automated mechanisms or manual processes required to assist users in making information sharing/collaboration decisions.	The organization being inspected/assessed implements the process defined in AC-21, CCI 1472 to assist users in making information sharing/collaboration decisions.	The organization conducting the inspection/assessment obtains and examines the documented process defined per AC-21, CCI 1472 to ensure the organization being inspected/assessed assists users in making information sharing/collaboration decisions.	TRUE		X		X						Enclave Non-Designer	---
368	AC-21	AC-21(b)	CCI-001472	The organization defines the automated mechanisms or manual processes required to assist users in making information sharing/collaboration decisions.	The organization being inspected/assessed defines and documents the automated mechanisms or manual processes required to assist users in making information sharing/collaboration decisions. DoD has determined the automated mechanisms or	The organization conducting the inspection/assessment obtains and examines the documented automated mechanisms to ensure the organization being inspected/assessed defines the automated mechanisms or manual processes required to assist users in making information sharing/collaboration decisions.	TRUE		X		X						Enclave Non-Designer	---
372	AC-22	AC-22(a)	CCI-001473	The organization designates individuals authorized to post information onto a publicly accessible information system.	The organization being inspected/assessed identifies and documents individuals authorized to post information onto a publicly accessible information system.	The organization conducting the inspection/assessment obtains and examines the list of individuals to ensure the organization being inspected/assessed designates individuals authorized to post information onto a publicly accessible information system.	FALSE							X			0	---
373	AC-22	AC-22(b)	CCI-001474	The organization trains authorized individuals to ensure that publicly accessible information does not contain nonpublic information.	The organization being inspected/assessed documents and implements a process to train authorized individuals to ensure that publicly accessible information does not contain nonpublic information. The organization must maintain an audit trail of the training conducted.	The organization conducting the inspection/assessment obtains and examines the documented process as well as the audit trail of the training conducted to ensure the organization being inspected/assessed trains authorized individuals to ensure that publicly accessible information does not contain nonpublic information.	FALSE							X			0	---
374	AC-22	AC-22(c)	CCI-001475	The organization reviews the proposed content of information prior to posting onto the publicly accessible information system to ensure that nonpublic information is not included.	The organization being inspected/assessed	The organization conducting the inspection/assessment obtains and examines	FALSE							X			0	---
375	AC-22	AC-22(d)	CCI-001476	The organization reviews the content on the publicly accessible information system for nonpublic information on an organization-defined frequency.	The organization being inspected/assessed documents and implements a process to review the content on the publicly accessible information system for nonpublic information on an organization-defined frequency. The organization must maintain an audit trail of reviews.	The organization conducting the inspection/assessment obtains and examines the documented process as well as the audit trail of reviews to ensure the organization being inspected/assessed reviews the content on the publicly accessible information system for nonpublic information on an organization-defined frequency.	FALSE							X			0	---
376	AC-22	AC-22(d)	CCI-001477	The organization defines a frequency for reviewing the content on the publicly accessible information system for nonpublic information.	DoD has defined the frequency as every 90 days or as new information is posted.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as every 90 days or as new information is posted.	FALSE							X			0	---

411	AT-3	AT-3(a)	CCI-000108	The organization provides role-based security training to personnel with assigned security roles and responsibilities before authorizing access to the information system or performing assigned duties	DoDD 8570.01 meets the DoD requirement for IA awareness training policy and procedures. DISA's DoD IA awareness CBT for privileged users is the DoD baseline standard. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDD 8570.01.	DoDD 8570.01 meets the DoD requirement for IA awareness training policy and procedures. DISA's DoD IA awareness CBT for privileged users is the DoD baseline standard. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDD 8570.01.	TRUE	X								DoD-Defined	---
412	AT-3	AT-3(b)	CCI-000109	The organization provides role-based security training to personnel with assigned security roles and responsibilities when required by information system changes.	Privileged user type Security-related education/training available through DISA IASE (e.g. VTE, Skill Soft, other professional sources) meets the provision of this control. The organization being inspected/assessed may define specific requirements within the above listed sources for their personnel.	The organization conducting the inspection/assessment obtains and examines documented records (IAW AT-4) of their privileged users training.	TRUE				X					Non-Designer	---
413	AT-3	AT-3(c)	CCI-000110	The organization provides refresher role-based security training to personnel with assigned security roles and responsibilities in accordance with organization-defined frequency.	Privileged user type Security-related education/training available through DISA IASE (e.g. VTE, Skill Soft, other professional sources) meets the provision of this control. The organization being inspected/assessed may define specific requirements within the above listed sources for their personnel.	The organization conducting the inspection/assessment obtains and examines documented records (IAW AT-4) of their privileged users training.	TRUE				X					Non-Designer	---
414	AT-3	AT-3(c)	CCI-000111	The organization defines a frequency for providing refresher role-based security training.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as annually.	TRUE	X								DoD-Defined	---
426	AT-4	AT-4(a)	CCI-000113	The organization documents individual information system security training activities, including basic security awareness training and specific information system security training.	The organization being inspected/assessed identifies and documents training activities to include basic security awareness training (per AT-2) and role-based security related training (per AT-3) IAW DoD 8570.01M.	The organization conducting the inspection/assessment obtains and examines the security awareness training activities to ensure the organization being inspected/assessed documents training activities to include basic security awareness training (per AT-2) and role-based security related training (per AT-3) IAW DoD 8570.01M.	TRUE				X					Non-Designer	---
427	AT-4	AT-4(a)	CCI-000114	The organization monitors individual information system security training activities, including basic security awareness training and specific information system security training.	The organization being inspected/assessed maintains and monitors records identifying personnel who have received training and the date the training was received	The organization conducting the inspection/assessment obtains and examines records identifying personnel who have received training and the date the training was received	TRUE				X					Non-Designer	---
428	AT-4	AT-4(b)	CCI-001336	The organization retains individual training records for an organization-defined time period.	The organization being inspected/assessed will maintain records training records for at least 5 years or 5 years after completion of a specific training program. DoD has defined the frequency as at least 5 years or 5 years after completion of a specific training program.	The organization conducting the inspection/assessment obtains and examines training records to ensure records have been maintained for at least 5 years or 5 years after completion of a specific training program. DoD has defined the frequency as at least 5 years or 5 years after completion of a specific training program.	TRUE				X					Non-Designer	---
429	AT-4	AT-4(b)	CCI-001337	The organization defines a time period for retaining individual training records.	DoD has defined the frequency as at least 5 years or 5 years after completion of a specific training program.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as at least 5 years or 5 years after completion of a specific training program.	TRUE	X								DoD-Defined	---
430	AU-1	AU-1(a)	CCI-001930	The organization defines the organizational personnel or roles to whom the audit and accountability policy is to be disseminated.	The organization being inspected/assessed defines and documents any personnel or roles, in addition to the ISSO or ISSM, to whom the audit and accountability policy is to be disseminated. If there are no additional personnel or roles, the organization must also document that. DoD has defined the personnel or roles as the ISSO and	The organization conducting the inspection/assessment obtains and examines the documented list of personnel or roles to whom the audit and accountability policy is to be disseminated to ensure the organization being inspected/assessed has either defined additional personnel or roles, or identified that there are no additional personnel or roles. DoD has defined the personnel or roles as the ISSO and ISSM and others as the local organization deems appropriate.	TRUE	X								DoD-Defined	---
431	AU-1	AU-1(a)	CCI-001931	The organization defines the organizational personnel or roles to whom the audit and accountability procedures are to be disseminated.	The organization being inspected/assessed defines and documents any personnel or roles, in addition to the ISSO or ISSM, to whom the audit and accountability procedures are to be disseminated. If there are no additional personnel or roles, the organization must also document that. DoD has defined the personnel or roles as the ISSO and	The organization conducting the inspection/assessment obtains and examines the documented list of personnel or roles to whom the audit and accountability procedures are to be disseminated to ensure the organization being inspected/assessed has either defined additional personnel or roles, or identified that there are no additional personnel or roles. DoD has defined the personnel or roles as the ISSO and ISSM and others as the local organization deems appropriate.	TRUE	X								DoD-Defined	---
432	AU-1	AU-1(a)(1)	CCI-000117	The organization develops and documents an audit and accountability policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	The organization being inspected/assessed develops and documents an audit and accountability policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	The organization conducting the inspection/assessment obtains and examines the audit and accountability policy to ensure that the audit and accountability policy addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	TRUE				X					Non-Designer	---
433	AU-1	AU-1(a)(1)	CCI-001832	The organization disseminates the audit and accountability policy to organization-defined personnel or roles.	The organization being inspected/assessed disseminates, via an information sharing capability, to the ISSO and ISSM and others as the local organization deems appropriate an audit and accountability policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance. DoD has defined the personnel or roles as the ISSO and ISSM and others as the local organization deems appropriate.	The organization conducting the inspection/assessment obtains and examines the audit and accountability procedures via the inspected organization's information sharing capability (e.g. portal, intranet, email, etc.) to ensure it has been disseminated.	TRUE				X					Non-Designer	---

645	CA-5	CA-5(a)	CCI-000264	The organization develops a plan of action and milestones for the information system to document the organizations planned remedial actions to correct weaknesses or deficiencies noted during the assessment of the security controls and to reduce or eliminate known vulnerabilities in the system.	The organization being inspected/assessed will develop a security POA&M in accordance with DoDI 8510.01 Enclosure 6. POA&M templates are available on the Knowledge Service.	The organization conducting the inspection/assessment obtains and examines the security POA&M for compliance with DoDI 8510.01.	TRUE				X						Non-Designer	---
646	CA-5	CA-5(b)	CCI-000265	The organization defines the frequency to update existing plan of action and milestones for the information system.	DoD has defined the frequency as at least every 90 days. POA&M templates are available on the Knowledge Service.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as at least every 90 days.	TRUE	X									DoD-Defined	---
647	CA-5	CA-5(b)	CCI-000266	The organization updates, on an organization-defined frequency, existing plan of action and milestones based on the findings from security controls assessments, security impact analyses, and continuous monitoring activities.	The organization being inspected/assessed will update the POA&M at least every 90 days.	The organization conducting the inspection/assessment obtains and examines current POA&M. The objective is to validate the organization is providing updates to the POA&M at least every 90 days. Review of POA&M without change must be documented (i.e., adding review date to the POA&M header	TRUE				X						Non-Designer	---
651	CA-6	CA-6(a)	CCI-000270	The organization assigns a senior-level executive or manager as the authorizing official for the information system.	The organization being inspected/assessed will assign a senior-level executive or manager as the official role, and the responsibility, for authorizing the information system(s). Assignment must be in writing and IAW with DoDI 8510.01 (i.e. Appointment memorandum).	The organization conducting the inspection/assessment obtains and examines the written appointment memorandum.	TRUE				X	X					Non-Designer Impractical	---
652	CA-6	CA-6(b)	CCI-000271	The organization ensures the authorizing official authorizes the information system for processing before commencing operations.	The organization being inspected/assessed will ensure that an authorization document (e.g. authorization to operate (ATO), interim authorization to operate (IATO)) has been issued by the authorizing official (AO) prior to	The organization conducting the inspection/assessment obtains and examines the authorization document to ensure the information system is authorized prior to being placed into operational status.	TRUE				X						Non-Designer	---
653	CA-6	CA-6(c)	CCI-000273	The organization defines the frequency of updating the security authorization.	DoD has defined the frequency as at least every three years, whenever there is a significant change to the system, or if there is a change to the environment in which the system operates.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as at least every three years, whenever there is a significant change to the system, or if there is a change to the environment in which the system operates.	TRUE	X									DoD-Defined	---
654	CA-6	CA-6(c)	CCI-000272	The organization updates the security authorization on an organization-defined frequency.	The organization being inspected/assessed updates the security authorization at least every three years, whenever there is a significant change to the system, or if there is a change to the environment in which the	The organization conducting the inspection/assessment obtains and examines the security authorization documentation to confirm the security authorization has been updated within the last three years, when there was a significant change to the system, or if there was a change to the environment in which	TRUE				X						Non-Designer	---
655	CA-7	CA-7	CCI-000274	The organization develops a continuous monitoring strategy.	Future DoD-wide CM guidance to be published	Future DoD-wide CM guidance to be published	TRUE				X						Non-Designer	---
656	CA-7	CA-7(a)	CCI-002087	The organization establishes and defines the metrics to be monitored for the continuous monitoring program.	Future DoD-wide CM guidance to be published	Future DoD-wide CM guidance to be published	TRUE				X						Non-Designer	---
657	CA-7	CA-7(b)	CCI-002088	The organization establishes and defines the frequencies for continuous monitoring.	Future DoD-wide CM guidance to be published	Future DoD-wide CM guidance to be published	TRUE				X						Non-Designer	---
658	CA-7	CA-7(b)	CCI-002089	The organization establishes and defines the frequencies for assessments supporting continuous monitoring.	Future DoD-wide CM guidance to be published	Future DoD-wide CM guidance to be published	TRUE				X						Non-Designer	---
659	CA-7	CA-7(c)	CCI-000279	The organization implements a continuous monitoring program that includes ongoing security control assessments in accordance with the organizational continuous monitoring strategy.	Future DoD-wide CM guidance to be published	Future DoD-wide CM guidance to be published	TRUE				X						Non-Designer	---
660	CA-7	CA-7(d)	CCI-002090	The organization implements a continuous monitoring program that includes ongoing security status monitoring of organization-defined metrics in accordance with the organizational continuous monitoring strategy.	Future DoD-wide CM guidance to be published	Future DoD-wide CM guidance to be published	TRUE				X						Non-Designer	---
661	CA-7	CA-7(e)	CCI-002091	The organization implements a continuous monitoring program that includes correlation and analysis of security-related information generated by assessments and	Future DoD-wide CM guidance to be published	Future DoD-wide CM guidance to be published	TRUE				X						Non-Designer	---
662	CA-7	CA-7(f)	CCI-002092	The organization implements a continuous monitoring program that includes response actions to address results of the analysis of security-related information.	Future DoD-wide CM guidance to be published	Future DoD-wide CM guidance to be published	TRUE				X						Non-Designer	---
663	CA-7	CA-7(g)	CCI-000281	The organization defines the frequency to report the security status of organization and the information system to organization-defined personnel or roles.	Future DoD-wide CM guidance to be published	Future DoD-wide CM guidance to be published	TRUE				X						Non-Designer	---
664	CA-7	CA-7(g)	CCI-001581	The organization defines personnel or roles to whom the security status of organization and the information system should be reported.	Future DoD-wide CM guidance to be published	Future DoD-wide CM guidance to be published	TRUE				X						Non-Designer	---

665	CA-7	CA-7(g)	CCI-000280	The organization implements a continuous monitoring program that includes reporting the security status of organization and the information system to organization-defined personnel or roles on an organization-defined frequency.	Future DoD-wide CM guidance to be published	Future DoD-wide CM guidance to be published	TRUE					X					Non-Designer	---
676	CA-9	CA-9(a)	CCI-002101	The organization authorizes internal connections of organization-defined information system components or classes of components to the information system.	The organization being inspected/assessed authorizes internal connections of information system components defined in CA-9, CCI 2102 or classes of components to the information system. The organization must maintain an audit trail of authorizations.	The organization conducting the inspection/assessment obtains and examines the audit trail of authorizations to ensure the organization being inspected/assessed authorizes internal connections of information system components defined in CA-9, CCI 2102 or classes of components to the information system.	TRUE					X					Non-Designer	---
682	CM-1	CM-1(a)	CCI-001821	The organization defines the organizational personnel or roles to whom the configuration management policy is to be disseminated.	DoD has defined the organizational personnel or roles as all stakeholders in the configuration management process.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the organizational personnel or roles as all stakeholders in	TRUE					X					Non-Designer	---
683	CM-1	CM-1(a)	CCI-001824	The organization defines the organizational personnel or roles to whom the configuration management procedures are to be disseminated.	DoD has defined the organizational personnel or roles as all stakeholders in the configuration management process.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the organizational personnel or roles as all stakeholders in	TRUE	X				X					DoD-Defined Non-Designer	---
684	CM-1	CM-1(a)(1)	CCI-000287	The organization develops and documents a configuration management policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	The organization being inspected/assessed develops and documents a configuration management policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	The organization conducting the inspection/assessment obtains and examines the configuration management policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	TRUE					X					Non-Designer	---
685	CM-1	CM-1(a)(1)	CCI-001822	The organization disseminates the configuration management policy to organization defined personnel or roles.	The organization being inspected/assessed disseminates a configuration management policy via an information sharing capability (e.g. portal, intranet, email, etc.) to all stakeholders in the configuration management process. DoD has defined the organizational personnel or roles as all stakeholders in the configuration management	The organization conducting the inspection/assessment obtains and examines the configuration management policy via the inspected organization's information sharing capability (e.g. portal, intranet, email, etc.) to ensure it has been disseminated.	TRUE					X					Non-Designer	---
686	CM-1	CM-1(a)(2)	CCI-000290	The organization develops and documents procedures to facilitate the implementation of the configuration management policy and associated configuration management controls.	The organization being inspected/assessed develops and documents procedures to facilitate the implementation of the configuration management policy and associated configuration management controls.	The organization conducting the inspection/assessment obtains and examines the procedures to facilitate the implementation of the configuration management policy and associated configuration management controls.	TRUE					X					Non-Designer	---
687	CM-1	CM-1(a)(2)	CCI-001825	The organization disseminates to organization defined personnel or roles the procedures to facilitate the implementation of the configuration management policy and associated configuration management controls.	The organization being inspected/assessed disseminates the procedures to facilitate the implementation of the configuration management policy and associated configuration management controls via an information sharing capability (e.g. portal, intranet, email, etc.) to all stakeholders in the configuration management process. DoD has defined the organizational personnel or roles as all stakeholders in the configuration management process.	The organization conducting the inspection/assessment obtains and examines the procedures to facilitate the implementation of the configuration management policy and associated configuration management controls via the inspected organization's information sharing capability (e.g. portal, intranet, email, etc.) to ensure it has been disseminated.	TRUE					X					Non-Designer	---
688	CM-1	CM-1(b)(1)	CCI-000289	The organization reviews and updates, on an organization defined frequency, the configuration management policy.	The organization being inspected/assessed reviews and updates, annually, the configuration management policy. The organization must document each occurrence of the reviews and update actions as an audit trail. DoD has defined the frequency as annually.	The organization conducting the inspection/assessment obtains and examines documentation of occurrence of reviews and update actions for the configuration management policy to ensure annual review and necessary updates are occurring. DoD has defined the frequency as annually.	TRUE					X					Non-Designer	---
689	CM-1	CM-1(b)(1)	CCI-000286	The organization defines a frequency to review and update the configuration management policies.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as annually.	TRUE	X				X					DoD-Defined Non-Designer	---
690	CM-1	CM-1(b)(2)	CCI-000292	The organization reviews and updates, on an organization defined frequency, the procedures to facilitate the implementation of the configuration management policy and associated configuration management controls.	The organization being inspected/assessed reviews and updates, annually, the procedures to facilitate the implementation of the configuration management policy and associated configuration management controls. The organization must document each occurrence of the reviews and update actions as an audit trail.	The organization conducting the inspection/assessment obtains and examines documentation of occurrence of reviews and update actions for the procedures to facilitate the implementation of the configuration management policy and associated configuration management controls to ensure annual review and necessary updates are occurring. DoD has defined the frequency as annually.	TRUE					X					Non-Designer	---
691	CM-1	CM-1(b)(2)	CCI-001584	The organization defines the frequency to review and update configuration management procedures.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as annually.	TRUE	X				X					DoD-Defined Non-Designer	---
693	CM-2	CM-2	CCI-000295	The organization maintains under configuration control, a current baseline configuration of the information system.	The organization being inspected/assessed maintains a current baseline configuration of the information system	The organization conducting the inspection/assessment obtains and examines the current baseline to ensure the current configuration matches the current documented baseline.	TRUE					X					Non-Designer	---
744	CM-4	CM-4	CCI-000333	The organization analyzes changes to the information system to determine potential security impacts prior to change implementation.	The organization being inspected/assessed analyzes changes to the information system to determine potential security impacts prior to change implementation. The organization must maintain records of analysis of changes to the information system.	The organization conducting the inspection/assessment obtains and examines the records of analyses to ensure the organization is conducting a security impact analysis of changes to the information system(s) prior to their implementation.	TRUE					X					Non-Designer	---
782	CM-6	CM-6(b)	CCI-000366	The organization implements the security configuration settings.	The organization being inspected/assessed must develop and document a process for implementing DoD security configuration or implementation guidance (e.g. STIGs, NSA configuration guides, CTOs, DTMs etc.). DoD has defined the security configuration checklists as DoD security configuration or implementation guidance (e.g. STIGs, NSA configuration guides, CTOs, DTMs etc.).	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed implements DoD security configuration or implementation guidance (e.g. STIGs, NSA configuration guides, CTOs, DTMs etc.). The organization conducting the inspection/assessment tests a sampling of information system components to ensure they comply with the required settings.	TRUE					X					Non-Designer	---
784	CM-6	CM-6(c)	CCI-001756	The organization defines the operational requirements on which the configuration settings for the organization-defined information system components are to be based.	The organization being inspected/assessed must define and document in the system security plan, the requirements which may deviate from the approved configuration settings on the information system components defined in CM-6, CCI 1755. DoD has determined that it is not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the system security plan to ensure the organization being inspected/assessed defines the requirements which may deviate from the approved configuration settings on the information system components defined in CM-6, CCI 1755. DoD has determined that it is not appropriate to define at the Enterprise level.	TRUE					X					Non-Designer	---

785	CM-6	CM-6(c)	CCI-000367	The organization identifies any deviations from the established configuration settings for organization-defined information system components based on organization-defined operational requirements.	The organization being inspected/assessed documents in the security plan and POA&M, if applicable, the information system components as defined in CM-6, CCI 1755 which deviate from configuration settings, and which settings as defined in CM-6, CCI 1756.	The organization conducting the inspection/assessment obtains and examines the security plan to ensure the organization being inspected/assessed has documented deviations from configuration settings for information system components.	TRUE				X	X				Non-Designer Impractical	---
786	CM-6	CM-6(c)	CCI-000368	The organization documents any deviations from the established configuration settings for organization-defined information system components based on organization-defined operational requirements.	The organization being inspected/assessed documents in the security plan and POA&M, if applicable, all configurable information system components which deviate from configuration settings, and which settings as defined in CM-6, CCI 1756.	The organization conducting the inspection/assessment obtains and examines the security plan to ensure the organization being inspected/assessed has documented deviations from configuration settings for information system components.	TRUE				X	X				Non-Designer Impractical	---
787	CM-6	CM-6(c)	CCI-000369	The organization approves any deviations from the established configuration settings for organization-defined information system components based on organization-defined operational requirements.	The organization being inspected/assessed manages and approves changes to the security plan documenting deviations IAW CM-3, CCI 314.	The organization conducting the inspection/assessment obtains and examines the security plan and the audit trail of approved changes to ensure the deviations are approved IAW CM-3, CCI 314.	TRUE				X					Non-Designer	---
788	CM-6	CM-6(d)	CCI-001502	The organization monitors changes to the configuration settings in accordance with organizational policies and procedures.	The organization being inspected/assessed develops and documents a process for monitoring changes to the configuration settings in accordance with organizational policies and procedures.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed monitors changes to the configuration settings in accordance with organizational policies and procedures.	TRUE				X					Non-Designer	---
789	CM-6	CM-6(d)	CCI-001503	The organization controls changes to the configuration settings in accordance with organizational policies and procedures.	The organization being inspected/assessed develops and documents a process for controlling changes to the configuration settings in accordance with organizational policies and procedures.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed controls changes to the configuration settings in accordance with organizational policies and procedures.	TRUE				X					Non-Designer	---
801	CM-7(1)	CM-7(1)(a)	CCI-000384	The organization reviews the information system per organization defined frequency to identify unnecessary and nonsecure functions, ports, protocols, and services.	The organization being inspected/assessed documents and implements a process to review the information system every 30 days to identify unnecessary and nonsecure functions, ports, protocols, and services. The organization must maintain an audit trail of the reviews. DoD has defined the frequency as every 30 days.	The organization conducting the inspection/assessment obtains and examines the documented process and audit trail of reviews to ensure the organization being inspected/assessed reviews the information system every 30 days to identify unnecessary and nonsecure functions, ports, protocols, and services. DoD has defined the frequency as every 30 days.	TRUE				X					Non-Designer	---
802	CM-7(1)	CM-7(1)(a)	CCI-001760	The organization defines the frequency of information system reviews to identify unnecessary and/or nonsecure functions, ports, protocols, and services.	DoD has defined the frequency as every 30 days.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as every 30 days.	TRUE	X				X				DoD-Defined Impractical	---
820	CM-8	CM-8(a)(3)	CCI-000395	The organization develops and documents an inventory of information system components that is at the level of granularity deemed necessary for tracking and reporting.	The organization being inspected/assessed documents inventory of information system components that is at the level of granularity deemed necessary for tracking and reporting.	The organization conducting the inspection/assessment obtains and examines the documented inventory and examines a sampling of information system components to ensure inventory is at the level of granularity deemed necessary for tracking and reporting.	TRUE				X					Non-Designer	---
821	CM-8	CM-8(a)(4)	CCI-000399	The organization develops and documents an inventory of information system components that includes organization defined information deemed necessary to achieve effective information system component accountability.	The organization being inspected/assessed documents inventory of information system components that includes organization defined information deemed necessary to achieve effective information system component accountability.	The organization conducting the inspection/assessment obtains and examines the documented inventory and examines a sampling of information system components to ensure inventory includes organization defined information deemed necessary to achieve effective information system component accountability.	TRUE				X					Non-Designer	---
822	CM-8	CM-8(b)	CCI-001779	The organization defines the frequency on which the information system component inventory is to be reviewed and updated	DoD has defined the frequency as at a minimum, annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as at a minimum, annually.	TRUE	X			X	X				DoD-Defined Non-Designer Impractical	---
823	CM-8	CM-8(b)	CCI-001780	The organization reviews and updates the information system component inventory per organization-defined frequency.	The organization being inspected/assessed documents and implements a process to review and update the information system component inventory at a minimum, annually. The organization must maintain an audit trail of review and update activity. DoD has defined the frequency as at a minimum, annually.	The organization conducting the inspection/assessment obtains and examines the documented process for reviews and updates as well as the audit trail of reviews and updates to ensure the organization being inspected/assessed reviews and updates the information system component inventory at a minimum, annually. DoD has defined the frequency as at a minimum, annually.	TRUE				X					Non-Designer	---
859	CM-10	CM-10(a)	CCI-001726	The organization uses software in accordance with contract agreements.	The organization being inspected/assessed uses software in accordance with contract agreements.	The organization conducting the inspection/assessment obtains and examines a sampling of contract agreements and supporting evidence concerning the usage of software to ensure compliance with the contract agreements.	TRUE				X					Non-Designer	---
860	CM-10	CM-10(a)	CCI-001727	The organization uses software documentation in accordance with contract agreements.	The organization being inspected/assessed uses software documentation in accordance with contract agreements.	The organization conducting the inspection/assessment obtains and examines a sampling of contract agreements associated with software documentation and supporting evidence concerning the usage of software documentation to ensure compliance with contract agreements.	TRUE				X					Non-Designer	---
861	CM-10	CM-10(a)	CCI-001728	The organization uses software in accordance with copyright laws.	The organization being inspected/assessed uses software in accordance with copyright laws.	The organization conducting the inspection/assessment obtains and examines supporting evidence concerning the usage of software to ensure compliance with copyright laws.	TRUE				X					Non-Designer	---
862	CM-10	CM-10(a)	CCI-001729	The organization uses software documentation in accordance with copyright laws.	The organization being inspected/assessed uses software documentation in accordance with copyright laws.	The organization conducting the inspection/assessment obtains and examines supporting evidence concerning the usage of software documentation to ensure compliance with copyright laws.	TRUE				X					Non-Designer	---

863	CM-10	CM-10(b)	CCI-001730	The organization tracks the use of software protected by quantity licenses to control copying of the software.	The organization being inspected/assessed tracks the use of software protected by quantity licenses to control copying of the software. Software license tracking can be accomplished by manual methods (e.g., simple spreadsheets) or automated methods (e.g., specialized tracking applications) depending on organizational needs.	The organization conducting the inspection/assessment obtains and examines the tracking records to ensure the organization being inspected/assessed tracks the use of software protected by quantity licenses to control copying of the software.	TRUE				X						Non-Designer	---
864	CM-10	CM-10(b)	CCI-001802	The organization tracks the use of software documentation protected by quantity licenses to control copying of the software documentation.	The organization being inspected/assessed tracks the use of software documentation protected by quantity licenses to control copying of the software documentation.	The organization conducting the inspection/assessment obtains and examines the tracking records to ensure the organization being inspected/assessed tracks the use of software documentation protected by quantity licenses to control copying of the software documentation.	TRUE				X						Non-Designer	---
865	CM-10	CM-10(b)	CCI-001803	The organization tracks the use of software protected by quantity licenses to control distribution of the software.	The organization being inspected/assessed tracks the use of software protected by quantity licenses to control distribution of the software. Software license tracking can be accomplished by manual methods (e.g., simple spreadsheets) or automated methods (e.g., specialized tracking applications) depending on organizational needs.	The organization conducting the inspection/assessment obtains and examines the tracking records to ensure the organization being inspected/assessed tracks the use of software protected by quantity licenses to control distribution of the software.	TRUE				X						Non-Designer	---
866	CM-10	CM-10(b)	CCI-001731	The organization tracks the use of software documentation protected by quantity licenses to control distribution of the software documentation.	The organization being inspected/assessed tracks the use of software documentation protected by quantity licenses to control distribution of the software documentation. Software license tracking can be accomplished by manual methods (e.g., simple spreadsheets) or automated methods (e.g., specialized tracking applications) depending on organizational needs.	The organization conducting the inspection/assessment obtains and examines the tracking records to ensure the organization being inspected/assessed tracks the use of software documentation protected by quantity licenses to control distribution of the software documentation.	TRUE				X						Non-Designer	---
867	CM-10	CM-10(c)	CCI-001732	The organization controls the use of peer-to-peer file sharing technology to ensure that this capability is not used for the unauthorized distribution, display, performance, or reproduction of copyrighted work.	The organization being inspected/assessed reviews and authorizes in order to control the use of peer-to-peer file sharing technology to ensure that this capability is not used for the unauthorized distribution, display, performance, or reproduction of copyrighted work.	The organization conducting the inspection/assessment obtains and examines the audit trail of peer-to-peer file sharing technology reviews and authorizations to ensure the organization being inspected/assessed controls the use of peer-to-peer file sharing technology to ensure that this capability is not used for the unauthorized distribution, display, performance, or reproduction of copyrighted work.	TRUE		X								Enclave	---
868	CM-10	CM-10(c)	CCI-001733	The organization documents the use of peer-to-peer file sharing technology to ensure that this capability is not used for the unauthorized distribution, display, performance, or reproduction of copyrighted work.	The organization being inspected/assessed documents the use of peer-to-peer file sharing technology to ensure that this capability is not used for the unauthorized distribution, display, performance, or reproduction of copyrighted work.	The organization conducting the inspection/assessment obtains and examines the documentation for the use of peer-to-peer file sharing technology to ensure that this capability is not used for the unauthorized distribution, display, performance, or reproduction of copyrighted work.	TRUE		X								Enclave	---
871	CM-11	CM-11(a)	CCI-001804	The organization defines the policies for governing the installation of software by users.	The organization being inspected/assessed must define policies governing the installation of software by users. DoD has determined the policies are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines policies governing the installation of software by users (e.g., user agreements, CM plan, etc.) to ensure the organization being inspected/assessed defines the policies for governing the installation of software by users.	TRUE				X						Non-Designer	---
872	CM-11	CM-11(a)	CCI-001805	The organization establishes organization-defined policies governing the installation of software by users.	The organization being inspected/assessed documents their policies governing the installation of software by users (e.g., user agreements, CM plan, etc.).	The organization conducting the inspection/assessment obtains and examines documented policies governing the installation of software by users (e.g., user agreements, CM plan, etc.) to ensure the organization being inspected/assessed establishes policies governing the installation of software by users.	TRUE				X						Non-Designer	---
873	CM-11	CM-11(b)	CCI-001806	The organization defines methods to be employed to enforce the software installation policies.	The organization being inspected/assessed must define and document the methods employed to enforce the software installation policies. DoD has determined the policies are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines documentation of the methods employed to ensure the organization being inspected/assessed defines methods to be employed to enforce the software installation policies. DoD has determined the policies are not appropriate to define at the Enterprise level.	TRUE				X						Non-Designer	---
874	CM-11	CM-11(b)	CCI-001807	The organization enforces software installation policies through organization-defined methods.	The organization being inspected/assessed must enforce software installation policies as defined in CM-11, CCI 1804 through methods defined in CM-11, CCI 1806.	The organization conducting the inspection/assessment obtains and examines software installation policies defined in CM-11, CCI 1804 and inspects the methods defined in CM-11, CCI 1806 to verify they are properly implemented.	TRUE				X						Non-Designer	---
875	CM-11	CM-11(c)	CCI-001808	The organization defines the frequency on which it will monitor software installation policy compliance.	DoD has defined the frequency as at least monthly.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as at least monthly.	TRUE	X									DoD-Defined	---
876	CM-11	CM-11(c)	CCI-001809	The organization monitors software installation policy compliance per organization-defined frequency.	The organization being inspected/assessed must monitor software installation policy compliance at least monthly. The organization must maintain audit trails of monitoring activity. DoD has defined the frequency as at least monthly.	The organization conducting the inspection/assessment obtains and examines the audit trails of monitoring activities to ensure the organization being inspected/assessed monitors software installation policy compliance at least monthly. DoD has defined the frequency as at least monthly.	TRUE				X						Non-Designer	---
880	CP-1	CP-1(a)(1)	CCI-002825	The organization defines personnel or roles to whom the contingency planning policy is to be disseminated.	DoD has defined the personnel or roles as all stakeholders identified in the contingency plan.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as all stakeholders identified in the contingency plan.	TRUE				X						Non-Designer	---

	CP-1	CP-1(a)(1)	CCI-000438	The organization develops and documents a contingency planning policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	DoDI 8500.01 and NIST SP 800-34 meet the DoD requirements for contingency planning policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8500.01 and NIST SP 800-34.	DoDI 8500.01 and NIST SP 800-34 meet the DoD requirements for contingency planning policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8500.01 and NIST SP 800-34.	TRUE	X								DoD-Defined	---
882	CP-1	CP-1(a)(1)	CCI-000439	The organization disseminates a contingency planning policy to organization-defined personnel or roles.	DoD disseminates DoDI 8500.01 organization-wide via the DoD Issuances website. http://www.dtic.mil/whs/directives/corres/dir.html NIST disseminates NIST SP 800-34 via http://csrc.nist.gov/publications/PubsSPs.html	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8500.01 and NIST SP 800-34.	TRUE				X					Non-Designer	---
883	CP-1	CP-1(a)(2)	CCI-002826	The organization defines personnel or roles to whom the contingency planning procedures are disseminated.	DoD has defined the personnel or roles as all stakeholders identified in the contingency plan.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as all stakeholders identified in the contingency plan.	TRUE				X					Non-Designer	---
884	CP-1	CP-1(a)(2)	CCI-000441	The organization develops and documents procedures to facilitate the implementation of the contingency planning policy and associated contingency planning controls.	DoDI 8500.01 and NIST SP 800-34 meet the DoD requirements for contingency planning policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8500.01 and NIST SP 800-34.	DoDI 8500.01 and NIST SP 800-34 meet the DoD requirements for contingency planning policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8500.01 and NIST SP 800-34.	TRUE	X								DoD-Defined	---
885	CP-1	CP-1(a)(2)	CCI-001597	The organization disseminates contingency planning procedures to organization-defined personnel or roles.	DoD disseminates DoDI 8500.01 organization-wide via the DoD Issuances website. http://www.dtic.mil/whs/directives/corres/dir.html NIST disseminates NIST SP 800-34 via http://csrc.nist.gov/publications/PubsSPs.html	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8500.01 and NIST SP 800-34.	TRUE				X					Non-Designer	---
886	CP-1	CP-1(b)(1)	CCI-000437	The organization defines the frequency to review and update the current contingency planning policy.	DoD has defined the frequency as every 5 years.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as every 5 years.	TRUE	X								DoD-Defined	---
887	CP-1	CP-1(b)(1)	CCI-000440	The organization reviews and updates the current contingency planning policy in accordance with organization-defined frequency.	DoDI 8500.01 and NIST SP 800-34 meet the DoD requirements for contingency planning policy and procedures.	DoDI 8500.01 and NIST SP 800-34 meet the DoD requirements for contingency planning policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8500.01 and NIST SP 800-34.	TRUE				X					Non-Designer	---
888	CP-1	CP-1(b)(2)	CCI-001596	The organization defines the frequency to review and update the current contingency planning procedures.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as annually.	TRUE	X								DoD-Defined	---
889	CP-1	CP-1(b)(2)	CCI-001598	The organization reviews and updates the current contingency planning procedures in accordance with the organization-defined frequency.	DoDI 8500.01 and NIST SP 800-34 meet the DoD requirements for contingency planning policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8500.01 and NIST SP 800-34.	DoDI 8500.01 and NIST SP 800-34 meet the DoD requirements for contingency planning policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8500.01 and NIST SP 800-34.	TRUE				X					Non-Designer	---
890	CP-2	CP-2(a)(1)	CCI-000443	The organization develops a contingency plan for the information system that identifies essential missions.	The organization being inspected/assessed must clearly and accurately document essential missions for its information system(s). Impact of loss of essential mission functions must be defined using CNSSI 1253.	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents essential missions for its information system(s).	TRUE				X		X		X	Non-Designer	---
891	CP-2	CP-2(a)(1)	CCI-000444	The organization develops a contingency plan for the information system that identifies essential business functions.	The organization being inspected/assessed must clearly and accurately document essential business functions for its information system(s). Impact of loss of essential business functions must be defined using CNSSI 1253.	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents essential business functions for its information system(s).	FALSE							X		0	---
892	CP-2	CP-2(a)(1)	CCI-000445	The organization develops a contingency plan for the information system that identifies associated contingency requirements.	The organization being inspected/assessed must clearly and accurately document associated contingency requirements for its information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents associated contingency requirements for its information system(s).	TRUE				X					Non-Designer	---
893	CP-2	CP-2(a)(2)	CCI-000446	The organization develops a contingency plan for the information system that provides recovery objectives.	The organization being inspected/assessed must clearly and accurately document recovery objectives for its information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents recovery objectives for its information system(s).	TRUE				X					Non-Designer	---
894	CP-2	CP-2(a)(2)	CCI-000447	The organization develops a contingency plan for the information system that provides restoration priorities.	The organization being inspected/assessed must clearly and accurately document restoration priorities for its information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents restoration priorities for its information system(s).	TRUE				X					Non-Designer	---

895	CP-2	CP-2(a)(2)	CCI-000448	The organization develops a contingency plan for the information system that provides metrics.	The organization being inspected/assessed must clearly and accurately document metrics for its information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents metrics for its information system(s).	TRUE				X						Non-Designer	---
896	CP-2	CP-2(a)(3)	CCI-000449	The organization develops a contingency plan for the information system that addresses contingency roles, responsibilities, assigned individuals with contact information.	The organization being inspected/assessed must clearly and accurately document maintaining business functions despite an information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents contingency roles, responsibilities, assigned individuals with contact information for its information system(s).	TRUE				X						Non-Designer	---
897	CP-2	CP-2(a)(4)	CCI-000450	The organization develops a contingency plan for the information system that addresses maintaining essential missions despite an information system disruption.	The organization being inspected/assessed must clearly and accurately document maintaining essential missions despite an information system disruption for its information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents maintaining essential missions despite an information system disruption for its information system(s).	TRUE				X		X		X		Non-Designer	---
898	CP-2	CP-2(a)(4)	CCI-000451	The organization develops a contingency plan for the information system that addresses maintaining essential business functions despite an information system disruption.	The organization being inspected/assessed must clearly and accurately document maintaining business functions despite an information system disruption for its information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents maintaining business functions despite an information system disruption for its information system(s).	FALSE							X			0	---
899	CP-2	CP-2(a)(4)	CCI-000452	The organization develops a contingency plan for the information system that addresses maintaining essential missions despite an information system compromise.	The organization being inspected/assessed must clearly and accurately document maintaining essential missions despite an information system compromise for its information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents maintaining essential missions despite an information system compromise for its information system(s).	TRUE				X		X		X		Non-Designer	---
900	CP-2	CP-2(a)(4)	CCI-000453	The organization develops a contingency plan for the information system that addresses maintaining essential business functions despite an information system compromise.	The organization being inspected/assessed must clearly and accurately document maintaining business functions despite an information system compromise for its information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents maintaining business functions despite an information system compromise for its information system(s).	FALSE							X			0	---
901	CP-2	CP-2(a)(4)	CCI-000454	The organization develops a contingency plan for the information system that addresses maintaining essential missions despite an information system failure.	The organization being inspected/assessed must clearly and accurately document maintaining essential missions despite an information system failure for its information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents maintaining essential missions despite an information system failure for its information system(s).	TRUE				X		X		X		Non-Designer	---
902	CP-2	CP-2(a)(4)	CCI-000455	The organization develops a contingency plan for the information system that addresses maintaining essential business functions despite an information system failure.	The organization being inspected/assessed must clearly and accurately document maintaining business functions despite an information system failure for its information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents maintaining business functions despite an information system failure for its information system(s).	FALSE							X			0	---
903	CP-2	CP-2(a)(5)	CCI-000456	The organization develops a contingency plan for the information system that addresses eventual, full information system restoration without deterioration of the security safeguards originally planned and implemented.	The organization being inspected/assessed must clearly and accurately document eventual, full information system restoration without deterioration of the security safeguards originally planned and implemented for its information system(s).	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it clearly and accurately documents eventual, full information system restoration without deterioration of the security safeguards originally planned and implemented for its information system(s).	TRUE				X						Non-Designer	---
904	CP-2	CP-2(a)(6)	CCI-000457	The organization develops a contingency plan for the information system that is reviewed and approved by organization-defined personnel or roles.	The organization being inspected/assessed reviews and approves the contingency plan by at a minimum, the ISSM and ISSO.	The organization conducting the inspection/assessment obtains and examines the audit trail to ensure the contingency plan has been reviewed and approved by at a minimum, the ISSM and ISSO.	TRUE				X						Non-Designer	---
905	CP-2	CP-2(a)(6)	CCI-002830	The organization defines the personnel or roles who review and approve the contingency plan for the information system.	DoD has defined the personnel or roles as at a minimum, the ISSM and ISSO.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as at a minimum, the ISSM and ISSO.	TRUE	X									DoD-Defined	---
906	CP-2	CP-2(b)	CCI-000458	The organization defines a list of key contingency personnel (identified by name and/or by role) and organizational elements designated to receive copies of the	DoD has defined the list as all stakeholders identified in the contingency plan.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE				X						Non-Designer	---
907	CP-2	CP-2(b)	CCI-000459	The organization distributes copies of the contingency plan to an organization-defined list of key contingency personnel (identified by name and/or by role) and organizational elements.	The organization being inspected/assessed ensures the contingency plan is disseminated to all stakeholders identified in the contingency plan via an information sharing capability. DoD has defined the list as all stakeholders identified in	The organization conducting the inspection/assessment obtains and examines the contingency plan via the inspected organization's information sharing capability (e.g. portal, intranet, email, etc.) to ensure it has been disseminated.	TRUE				X						Non-Designer	---
908	CP-2	CP-2(c)	CCI-000460	The organization coordinates contingency planning activities with incident handling activities.	The organization being inspected/assessed will coordinate the contingency plan and incident response plan (IR-8) to ensure they do not contradict each other's objectives or result in duplicate efforts/activities.	The organization conducting the inspection/assessment obtains and examines the contingency plan and the incident response plan (IR-8) to ensure they do not contradict each other's objectives or result in duplicate efforts/activities.	TRUE				X						Non-Designer	---
909	CP-2	CP-2(d)	CCI-000461	The organization defines the frequency to review the contingency plan for the information system.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as annually.	TRUE	X									DoD-Defined	---
910	CP-2	CP-2(d)	CCI-000462	The organization reviews the contingency plan for the information system in accordance with organization-defined frequency.	The organization being inspected/assessed annually reviews the contingency plan. The organization must maintain an audit trail of annual reviews.	The organization conducting the inspection/assessment obtains and examines the audit trail to ensure the contingency plan is reviewed annually.	TRUE				X						Non-Designer	---

911	CP-2	CP-2(e)	CCI-000463	The organization updates the contingency plan to address changes to the organization.	The organization being inspected/assessed must clearly and accurately update the contingency plan to address organizational changes. The organization must document the update activities as an audit trail.	The organization conducting the inspection/assessment obtains and examines the contingency plan and audit trail to ensure the organization clearly and accurately updates the contingency plan to address organizational changes.	TRUE				X						Non-Designer	---
912	CP-2	CP-2(e)	CCI-000464	The organization updates the contingency plan to address changes to the information system.	The organization being inspected/assessed must clearly and accurately update the contingency plan to address changes to the information system.	The organization conducting the inspection/assessment obtains and examines the contingency plan and audit trail to ensure the organization clearly and accurately updates the contingency plan to address information system changes.	TRUE				X						Non-Designer	---
913	CP-2	CP-2(e)	CCI-000465	The organization updates the contingency plan to address changes to the environment of operation.	The organization being inspected/assessed must clearly and accurately revise the contingency plan to address changes to the environment of operation. The organization must document the update activities as an audit trail.	The organization conducting the inspection/assessment obtains and examines the contingency plan and audit trail to ensure the organization clearly and accurately revises the contingency plan to address changes to the environment of operation.	TRUE				X						Non-Designer	---
914	CP-2	CP-2(e)	CCI-000466	The organization updates the contingency plan to address problems encountered during contingency plan implementation, execution, or testing.	The organization being inspected/assessed must clearly and accurately revise the contingency plan to address problems encountered during contingency plan implementation, execution, or testing. The organization must document the update activities as an audit trail.	The organization conducting the inspection/assessment obtains and examines the contingency plan and audit trail to ensure the organization clearly and accurately revises the contingency plan to address problems encountered during contingency plan implementation, execution, or testing.	TRUE				X						Non-Designer	---
915	CP-2	CP-2(f)	CCI-000468	The organization communicates contingency plan changes to organization-defined list of key contingency personnel (identified by name and/or by role) and organizational elements.	The organization being inspected/assessed communicates contingency plan changes to all stakeholders identified in the contingency plan. DoD has defined the list as all stakeholders identified in the contingency plan.	The organization conducting the inspection/assessment examines the contingency plan via the inspected organization's information sharing capability (e.g. portal, intranet, email, etc.) to ensure the most current version has been communicated.	TRUE				X						Non-Designer	---
916	CP-2	CP-2(f)	CCI-002831	The organization defines a list of key contingency personnel (identified by name and/or by role) and organizational elements to whom contingency plan changes are to be communicated.	DoD has defined the list as all stakeholders identified in the contingency plan	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the list as all stakeholders identified in the contingency plan	TRUE				X						Non-Designer	---
917	CP-2	CP-2(g)	CCI-002832	The organization protects the contingency plan from unauthorized disclosure and modification.	The organization being inspected/assessed documents and implements a process to protect the contingency plan from unauthorized disclosure and modification.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed protects the contingency plan from unauthorized disclosure and modification.	TRUE				X						Non-Designer	---
941	CP-3	CP-3(a)	CCI-002833	The organization defines the time period that contingency training is to be provided to information system users consistent with assigned roles and responsibilities within assuming a contingency role or responsibility.	DoD has defined the time period as at a maximum, 10 working days.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as at a maximum, 10 working days.	TRUE	X									DoD-Defined	---
942	CP-3	CP-3(a)	CCI-000486	The organization provides contingency training to information system users consistent with assigned roles and responsibilities within an organization-defined time period of assuming a contingency role or responsibility.	The organization being inspected/assessed provides initial contingency training to personnel with contingency roles and responsibilities IAW CP-2, CCI 449 at a maximum, 10 working days of assuming a contingency role or responsibility. The organization will maintain documentation of the training activity dates, location, and personnel for audit trail purposes and future reference (e.g., scheduling refresher training, etc.). DoD has defined the time period as at a maximum, 10 working days.	The organization conducting the inspection/assessment obtains and examines the list of contingency personnel and documentation of initial contingency training for the purpose of ensuring that all personnel with contingency roles and responsibilities have received initial contingency training at a maximum, 10 working days of assuming a contingency role or responsibility. DoD has defined the time period as at a maximum, 10 working days.	TRUE				X						Non-Designer	---
943	CP-3	CP-3(b)	CCI-002834	The organization provides contingency training to information system users consistent with assigned roles and responsibilities when required by information system changes.	The organization being inspected/assessed will update contingency training materials when required by information system changes and provide that training to personnel with contingency roles and responsibilities IAW CP-2, CCI 449. The organization will maintain documentation of the training activity dates, location, and personnel for audit trail purposes and future reference (e.g., scheduling refresher training, etc.).	The organization conducting the inspection/assessment obtains and examines training materials and documentation of training activities to determine whether the materials are accurate in consideration of the state of the information system and content of the contingency plan. The organization ensures that training is provided to users consistent with assigned roles and responsibilities.	TRUE				X						Non-Designer	---

944	CP-3	CP-3(c)	CCI-000485	The organization defines the frequency of refresher contingency training to information system users.	DoD has defined the frequency as at least annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as at least annually	TRUE	X									DoD-Defined	---
945	CP-3	CP-3(c)	CCI-000487	The organization provides refresher contingency training to information system users consistent with assigned roles and responsibilities in accordance with organization-defined frequency.	The organization being inspected/assessed provides refresher contingency training to personnel with contingency roles and responsibilities IAW CP-2, CCI 449 at least annually.	The organization conducting the inspection/assessment obtains and examines the list of contingency personnel and documentation of refresher contingency training for the purpose of ensuring that all personnel with contingency roles and responsibilities have received refresher contingency training at least annually.	TRUE				X						Non-Designer	---
948	CP-4	CP-4(a)	CCI-000490	The organization defines the frequency to test the contingency plan for the information system.	DoD has defined the frequency as at least annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as at least annually.	TRUE	X									DoD-Defined	---
949	CP-4	CP-4(a)	CCI-000492	The organization defines contingency plan tests to be conducted for the information system.	The organization being inspected/assessed defines and documents contingency plan tests to be conducted for the information system. DoD has determined the contingency plan tests are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented contingency plan tests to ensure the organization being inspected/assessed defines contingency plan tests to be conducted for the information system. DoD has determined the contingency plan tests are not appropriate to define at the Enterprise level.	TRUE				X						Non-Designer	---
950	CP-4	CP-4(a)	CCI-000494	The organization tests the contingency plan for the information system in accordance with organization-defined frequency using organization-defined tests to determine the effectiveness of the plan and the organizational readiness to execute the plan.	The organization being inspected/assessed conduct tests defined in CP-4, 492 at least annually to determine the effectiveness of the plan and the organizational readiness to execute the plan. The organization must maintain a record of test results. DoD has defined the frequency as at least annually.	The organization conducting the inspection/assessment obtains and examines the record of test results to ensure the organization being inspected/assessed conduct tests defined in CP-4, 492 at least annually to determine the effectiveness of the plan and the organizational readiness to execute the plan. DoD has defined the frequency as at least annually.	TRUE				X						Non-Designer	---
951	CP-4	CP-4(b)	CCI-000496	The organization reviews the contingency plan test results.	The organization being inspected/assessed will review the contingency plan test results. The organization must maintain an audit trail of issues identified during the reviews of the contingency plan test results.	The organization conducting the inspection/assessment obtains and examines the audit trail of issues identified during the reviews of the contingency plan test results to ensure the organization being inspected/assessed reviews the contingency plan test results.	TRUE				X						Non-Designer	---
952	CP-4	CP-4(c)	CCI-000497	The organization initiates corrective actions, if needed, after reviewing the contingency plan test results.	The organization being inspected/assessed identifies and documents any corrective actions required after reviewing the contingency plan test results. The organization initiates corrective actions and tracks those actions within the POA&M.	The organization conducting the inspection/assessment obtains and examines the contingency plan test results as well as any documented corrective actions required and ensures the corrective actions are being implemented and tracked within the POA&M.	TRUE				X						Non-Designer	---
999	CP-9	CP-9(a)	CCI-000534	The organization defines frequency of conducting user-level information backups to support recovery time objectives and recovery point objectives.	DoD has defined the frequency as at least weekly as defined in the contingency plan.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as at least weekly as defined in the contingency plan.	TRUE	X									DoD-Defined	---
1000	CP-9	CP-9(a)	CCI-000535	The organization conducts backups of user-level information contained in the information system per organization-defined frequency that is consistent with recovery time and recovery point objectives.	The organization being inspected/assessed must identify user level information within the backup strategy and configure the system to perform backups at least weekly as defined in the contingency plan.	The organization conducting the inspection/assessment obtains and reviews the backup strategy, and examines a sample of systems to ensure they are configured to perform back ups at least weekly as defined in the contingency plan.	TRUE		X		X						Enclave Non-Designer	---
1001	CP-9	CP-9(b)	CCI-000536	The organization defines frequency of conducting system-level information backups to support recovery time objectives and recovery point objectives.	DoD has defined the frequency as at least weekly and as required by system baseline configuration changes in accordance with the contingency plan.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as at least weekly and as required by system baseline configuration changes in accordance with the contingency plan.	TRUE				X						Non-Designer	---
1002	CP-9	CP-9(b)	CCI-000537	The organization conducts backups of system-level information contained in the information system per organization-defined frequency that is consistent with recovery time and recovery point objectives.	The organization being inspected/assessed must identify system-level information within the backup strategy and configure the system to perform backups at least weekly and as required by system baseline configuration changes in accordance with the contingency plan.	The organization conducting the inspection/assessment obtains and reviews the backup strategy, and examines a sample of systems to ensure they are configured to perform back ups at least weekly and as required by system baseline configuration changes in accordance with the contingency plan.	TRUE		X		X						Enclave Non-Designer	---
1003	CP-9	CP-9(c)	CCI-000538	The organization defines the frequency of conducting information system documentation backups including security-related documentation to support recovery time objectives and recovery point objectives.	DoD has defined the frequency as when created or received, when updated, and as required by system baseline configuration changes in accordance with the contingency plan.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as when created or received, when updated, and as required by system baseline configuration changes in accordance with the contingency plan.	TRUE				X						Non-Designer	---

1004	CP-9	CP-9(c)	CCI-000539	The organization conducts backups of information system documentation including security-related documentation per organization-defined frequency that is consistent with recovery time and recovery point objectives.	The organization being inspected/assessed conducts backups of information system documentation including security-related documentation when created or received, when updated, and as required by system baseline configuration changes in accordance with the contingency plan.	The organization conducting the inspection/assessment obtains and examines the latest version of the information system documentation including security-related documentation to verify it is the same version as contained in backups.	TRUE		X		X					Enclave Non-Designer	---
1005	CP-9	CP-9(d)	CCI-000540	The organization protects the confidentiality, integrity, and availability of backup information at storage locations.	The organization being inspected/assessed will protect the confidentiality, integrity, and availability of backup information at the storage location IAW the system security plan.	The organization conducting the inspection/assessment obtains and examines the system security plan and ensures backup information at the storage location is protected IAW the system security plan.	TRUE		X		X					Enclave Non-Designer	---
1034	IA-1	IA-1(a)	CCI-001933	The organization defines the personnel or roles to be recipients of the identification and authentication policy and the procedures to facilitate the implementation of the identification and authentication policy and associated identification and authentication controls.	DoD has defined the roles to be recipients of the identification and authentication policy and the procedures as the ISSO and ISSM and others as the local organization deems appropriate. DoDI 8520.02 and DoDI 8520.03 meet the DoD requirement for Identification and Authentication policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 8520.02 and DoDI 8520.03.	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8520.02 and DoDI 8520.03. DoD has defined the roles to be recipients of the identification and authentication policy and the procedures as the ISSO and ISSM and others as the local organization deems appropriate.	TRUE		X		X					Enclave Non-Designer	---
1035	IA-1	IA-1(a)	CCI-001934	The organization documents procedures to facilitate the implementation of the identification and authentication policy and associated identification and authentication controls.	DoD documents within DoDI 8520.02 and DoDI 8520.03 procedures to facilitate the implementation of the identification and authentication policy and associated identification and authentication controls. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 8520.02 and DoDI 8520.03.	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 8520.02 and DoDI 8520.03.	TRUE		X		X					Enclave Non-Designer	---
1036	IA-1	IA-1(a)(1)	CCI-000756	The organization develops and documents an identification and authentication policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	DoD developed DoDI 8520.02 and DoDI 8520.03 as the identification and authentication policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8520.02 and DoDI 8520.03.	TRUE		X		X					Enclave Non-Designer	---
1037	IA-1	IA-1(a)(1)	CCI-000757	The organization disseminates to organization defined personnel or roles an identification and authentication policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	DoD disseminates the DoDI 8520.02 and DoDI 8520.03 via the DoD Issuances website (http://www.dtic.mil/whs/directives/corres/dir.html) to the ISSO and ISSM and others as the local organization deems appropriate as an identification and authentication policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8520.02 and DoDI 8520.03. DoD has defined the personnel or roles to be recipients of the identification and authentication policy and the procedures as the ISSO and ISSM and others as the local organization deems appropriate.	TRUE		X		X					Enclave Non-Designer	---
1038	IA-1	IA-1(a)(1)	CCI-001932	The organization documents an identification and authentication policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	DoD documents within DoDI 8520.02 and DoDI 8520.03 an identification and authentication policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 8520.02 and DoDI 8520.03.	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 8520.02 and DoDI 8520.03.	TRUE		X		X					Enclave Non-Designer	---
1039	IA-1	IA-1(a)(2)	CCI-000760	The organization develops and documents procedures to facilitate the implementation of the identification and	DoD develops within DoDI 8520.02 and DoDI 8520.03, procedures to facilitate the implementation of the	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8520.02 and DoDI 8520.03.	TRUE		X		X					Enclave Non-Designer	---
1040	IA-1	IA-1(a)(2)	CCI-000761	The organization disseminates to organization-defined personnel or roles procedures to facilitate the	DoD disseminates the DoDI 8520.02 and DoDI 8520.03 to the ISSO and ISSM and others as the local	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8520.02 and DoDI 8520.03.	TRUE		X		X					Enclave Non-Designer	---
1041	IA-1	IA-1(b)(1)	CCI-000758	The organization reviews and updates identification and authentication policy in accordance with the organization	DoD reviews and updates identification and authentication policy (DoDI 8520.02 and DoDI 8520.03)	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8520.02 and DoDI 8520.03.	TRUE		X		X					Enclave Non-Designer	---
1042	IA-1	IA-1(b)(1)	CCI-000759	The organization defines a frequency for reviewing and updating the identification and authentication policy.	DoD has defined the frequency as reviewed annually - updated as appropriate but at least within 10 years of date of issuance.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X	X							DoD-Defined Enclave	---
1043	IA-1	IA-1(b)(2)	CCI-000762	The organization reviews and updates identification and authentication procedures in accordance with the organization defined frequency.	DoD reviews and updates identification and authentication procedures (DoDI 8520.02 and DoDI 8520.03) annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 8520.02 and DoDI 8520.03.	TRUE		X		X					Enclave Non-Designer	---
1044	IA-1	IA-1(b)(2)	CCI-000763	The organization defines a frequency for reviewing and updating the identification and authentication procedures.	DoD has defined the frequency as review annually - update as appropriate.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as review annually - update as appropriate.	TRUE	X	X							DoD-Defined Enclave	---
1088	IA-4	IA-4(a)	CCI-001970	The organization defines the personnel or roles that authorize the assignment of individual, group, role, and device identifiers.	DoD has defined the personnel or roles as the ISSM or ISSO.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as the ISSM or ISSO.	TRUE	X	X							DoD-Defined Enclave	---
1089	IA-4	IA-4(a)	CCI-001971	The organization manages information system identifiers by receiving authorization from organization-defined personnel or roles to assign an individual, group, role or	The organization being inspected/assessed implements a process to manage information system identifiers by receiving authorization from the ISSM or ISSO to	The organization conducting the inspection/assessment obtains and examines documentation and system configuration information to ensure the organization being inspected/assessed manages information system	TRUE		X		X					Enclave Non-Designer	---
1090	IA-4	IA-4(b)	CCI-001972	The organization manages information system identifiers by selecting an identifier that identifies an individual, group, role, or device.	The organization being inspected/assessed implements a process to manage information system identifiers by selecting an identifier that identifies an individual, group,	The organization conducting the inspection/assessment obtains and examines documentation or system configuration information to ensure the organization being inspected/assessed manages information system identifiers by selecting	TRUE		X		X					Enclave Non-Designer	---
1091	IA-4	IA-4(c)	CCI-001973	The organization manages information system identifiers by assigning the identifier to the intended individual, group, role, or device.	The organization being inspected/assessed implements a process to manage information system identifiers by assigning the identifier to the intended individual, group,	The organization conducting the inspection/assessment obtains and examines documentation or system configuration information to ensure the organization being inspected/assessed manages information system identifiers by	TRUE		X		X					Enclave Non-Designer	---
1092	IA-4	IA-4(d)	CCI-001974	The organization defines the time period for which the reuse of identifiers is prohibited.	DoD has defined the time period as 1 year for user identifiers (DoD is not going to specify value for device identifier).	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as 1 year for user identifiers (DoD is not going to specify value for device identifier).	TRUE		X		X					Enclave Non-Designer	---
1093	IA-4	IA-4(d)	CCI-001975	The organization manages information system identifiers by preventing reuse of identifiers for an organization-defined time period.	The organization being inspected/assessed implements a process for information system identifiers to prevent reuse of identifiers for 1 year for user identifiers (DoD is not going to specify value for device identifier).	The organization conducting the inspection/assessment obtains and examines documentation or system configuration information to ensure the organization being inspected/assessed prevents the reuse of identifiers for 1 year for user identifiers (DoD is not going to specify value for device identifier).	TRUE		X		X					Enclave Non-Designer	---
1094	IA-4	IA-4(e)	CCI-000794	The organization defines a time period of inactivity after which the identifier is disabled.	DoD has defined the time period as 35 days of inactivity.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as 35 days of inactivity.	TRUE	X	X							DoD-Defined Enclave	---
1095	IA-4	IA-4(e)	CCI-000795	The organization manages information system identifiers by disabling the identifier after an organization defined time period of inactivity.	The organization being inspected/assessed configures the information system to disable identifiers after 35 days of inactivity. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG	The organization conducting the inspection/assessment examines the information system configuration to ensure that identifiers are disabled after 35 days of inactivity. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the	TRUE		X		X					Enclave Non-Designer	---
1105	IA-5	IA-5	CCI-001988	The organization requires developers/installers of information system components to provide unique authenticators or change default authenticators prior to delivery/installation.	The organization being inspected/assessed documents and enforces a requirement for developers/installers of information system components to provide unique authenticators or change default authenticators prior to delivery/installation.	The organization conducting the inspection/assessment obtains and examines the documented requirements placed upon developers/installers of information system components to ensure that there is a documented requirement to provide unique authenticators or change default authenticators prior to delivery/installation.	0									0	---
1106	IA-5	IA-5(a)	CCI-001980	The organization manages information system authenticators by verifying, as part of the initial authenticator distribution, the identity of the individual, group, role, or device receiving the authenticator.	The organization being inspected/assessed defines and documents procedures for the secure distribution of authenticators. The process shall include verification of the identity of the individual, group, role, or device receiving the authenticator.	The organization conducting the inspection/assessment obtains and examines the documented procedures for the secure distribution of authenticators to ensure they have been defined and that they include a method to verify the identity of the individual, group, role, or device receiving the authenticator.	TRUE				X					Non-Designer	---

1109	IA-5	IA-5(d)	CCI-001984	The organization manages information system authenticators by establishing administrative procedures for revoking authenticators.	The organization being inspected/assessed defines and documents procedures for revoking authenticators.	The organization conducting the inspection/assessment obtains and examines the documented procedures for revoking authenticators to ensure the procedures are defined.	TRUE				X					Non-Designer	---
1110	IA-5	IA-5(d)	CCI-001985	The organization manages information system authenticators by implementing administrative procedures for initial authenticator distribution.	The organization being inspected/assessed implements administrative procedures for initial authenticator distribution as documented in IA-5, CCI's 1980 & 1981.	The organization conducting the inspection/assessment obtains and examines records of initial authenticator distribution and interviews individuals responsible for authenticator distribution to ensure that the organization being inspected/assessed implements the process as defined in IA-5, CCI's 1980 & 1981.	TRUE				X					Non-Designer	---
1111	IA-5	IA-5(d)	CCI-001986	The organization manages information system authenticators by implementing administrative procedures for lost/compromised authenticators.	The organization being inspected/assessed implements administrative procedures for the response to lost/compromised authenticators as documented in IA-5, CCI 1982.	The organization conducting the inspection/assessment obtains and examines documented procedures for the response to lost/compromised authenticators to ensure that the organization being inspected/assessed implements the process as defined in IA-5, CCI 1982.	TRUE				X					Non-Designer	---
1112	IA-5	IA-5(d)	CCI-001987	The organization manages information system authenticators by implementing administrative procedures for damaged authenticators.	The organization being inspected/assessed implements administrative procedures for the response to damaged authenticators as documented in IA-5, CCI 1983.	The organization conducting the inspection/assessment obtains and examines documented procedures for the response to damaged authenticators to ensure that the organization being inspected/assessed implements the process as defined in IA-5, CCI 1983.	TRUE				X					Non-Designer	---
1113	IA-5	IA-5(d)	CCI-001982	The organization manages information system authenticators by establishing administrative procedures for lost/compromised authenticators.	The organization being inspected/assessed defines and documents procedures for lost/compromised authenticators.	The organization conducting the inspection/assessment obtains and examines the documented procedures for lost/compromised authenticators to ensure they have been defined.	TRUE				X					Non-Designer	---
1114	IA-5	IA-5(d)	CCI-001981	The organization manages information system authenticators by establishing administrative procedures for initial authenticator distribution.	The organization being inspected/assessed defines and documents procedures for the secure distribution of authenticators.	The organization conducting the inspection/assessment obtains and examines the documented procedures for the secure distribution of authenticators to ensure they have been defined.	TRUE				X					Non-Designer	---
1115	IA-5	IA-5(d)	CCI-001983	The organization manages information system authenticators by establishing administrative procedures for damaged authenticators.	The organization being inspected/assessed defines and documents procedures for the secure disposal of damaged authenticators.	The organization conducting the inspection/assessment obtains and examines the documented procedures for the secure disposal of damaged authenticators to ensure they have been defined.	TRUE				X					Non-Designer	---
1117	IA-5	IA-5(f)	CCI-000180	The organization manages information system authenticators by establishing maximum lifetime restrictions for authenticators.	Per IA-5, CCI 1610, DoD has established the maximum lifetime restrictions for authenticators as CAC - every 3 years, or 1 year from term of contract Password: 60 days	Per IA-5, CCI 1610, DoD has established the maximum lifetime restrictions for authenticators as CAC - every 3 years, or 1 year from term of contract Password: 60 days Biometrics: every 3 years.	TRUE				X					Non-Designer	---
1118	IA-5	IA-5(f)	CCI-000181	The organization manages information system authenticators by establishing reuse conditions for authenticators.	The organization being inspected/assessed defines and documents the reuse conditions for authenticators.	The organization conducting the inspection/assessment obtains and examines the documented reuse conditions for authenticators to ensure they have been defined.	TRUE				X					Non-Designer	---
1119	IA-5	IA-5(f)	CCI-000179	The organization manages information system authenticators by establishing minimum lifetime restrictions for authenticators.	The organization being inspected/assessed defines and documents minimum lifetime restrictions for authenticators.	The organization conducting the inspection/assessment obtains and examines the documented minimum lifetime restrictions for authenticators to ensure they have been defined.	TRUE				X					Non-Designer	---
1122	IA-5	IA-5(h)	CCI-000183	The organization manages information system authenticators by protecting authenticator content from unauthorized disclosure.	The organization being inspected/assessed documents and implements procedures to protect authenticator content from unauthorized disclosure.	The organization conducting the inspection/assessment obtains and examines the documented procedures to protect authenticator content from unauthorized disclosure to ensure the procedures are defined.	TRUE				X					Non-Designer	---
1123	IA-5	IA-5(h)	CCI-002042	The organization manages information system authenticators by protecting authenticator content from unauthorized modification.	The organization being inspected/assessed configures the information system to manage information system authenticators by protecting authenticator content from unauthorized modification. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2042.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to manage information system authenticators by protecting authenticator content from unauthorized modification. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2042.	TRUE				X					Non-Designer	---
1124	IA-5	IA-5(i)	CCI-002366	The organization manages information system authenticators by having devices implement specific security safeguards to protect authenticators.	The organization being inspected/assessed configures the information system to manage information system authenticators by having devices implement, specific security safeguards to protect authenticators. For information system components that have	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to manage information system authenticators by having devices implement, specific security safeguards to protect authenticators.	TRUE				X					Non-Designer	---
1125	IA-5	IA-5(i)	CCI-002365	The organization manages information system authenticators by requiring individuals to take specific security safeguards to protect authenticators.	The organization being inspected/assessed documents within user agreements that individuals shall safeguard authenticators.	The organization conducting the inspection/assessment obtains and examines the user agreements of the organization being inspected/assessed to ensure that there are requirements for individuals to safeguard authenticators.	TRUE				X					Non-Designer	---
1126	IA-5	IA-5(j)	CCI-001990	The organization manages information system authenticators by changing authenticators for group/role accounts when membership to those accounts changes.	The organization being inspected/assessed documents and implements procedures for changing authenticators for group/role accounts when membership to those accounts changes.	The organization conducting the inspection/assessment obtains and examines the documented procedures for group/role authenticator change to ensure the procedures are defined and applied when membership to those accounts changes. The organization conducting the inspection/assessment obtains and examines a sampling of authenticator age data and documentation of personnel role changes to ensure that group/role authenticators are changed when membership changes.	TRUE		X		X					Enclave Non-Designer	---
1176	IA-8	IA-8	CCI-000804	The information system uniquely identifies and authenticates non-organizational users (or processes acting on behalf of non-organizational users).	The organization being inspected/assessed configures the information system to uniquely identify and authenticate non-organizational users (or processes acting on behalf of non-organizational users).	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to uniquely identify and authenticate non-organizational users (or processes acting on behalf of non-organizational users).	TRUE		X			X				Enclave Impractical	---

1217	IR-1	IR-1(b)(2)	CCI-000811	The organization reviews and updates the current incident response procedures in accordance with organization-defined frequency.	DoD (in conjunction with Joint Staff for CJCSIs) reviews and updates current incident response procedures (CJCSI 6510.01F, CJCSM 6510.01B, DoDD O-8530.1, and DoDI O-8530.2) annually. DoD Components are automatically compliant with this CCI because they are covered at the DoD level with the following policies: CJCSI 6510.01F, CJCSM 6510.01B, DoDD O-8530.1, and DoDI O-8530.2.	CJCSI 6510.01F "Information Assurance and Support to Computer Network Defense," CJCSM 6510.01B, "Cyber Incident Handling Program," DoDD O-8530.1, and DoDI O-8530.2 meet the DoD requirements for incident response policy and procedures. DoD Components are automatically compliant with this CCI because they are covered at the DoD level with the following policies: CJCSI 6510.01F, CJCSM 6510.01B, DoDD O-8530.1, and DoDI O-8530.2.	TRUE				X						Non-Designer	---
1218	IR-2	IR-2(a)	CCI-002778	The organization defines the time period in which information system users whom assume an incident response role or responsibility receive incident response training.	DoD has defined the time period as 30 working days.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as 30 working days.	TRUE	X									DoD-Defined	---
1219	IR-2	IR-2(a)	CCI-000813	The organization provides incident response training to information system users consistent with assigned roles and responsibilities within an organization-defined time period of assuming an incident response role or responsibility.	The organization being inspected/assessed documents and implement a process to provide incident response training to information system users consistent with assigned roles and responsibilities within 30 working days of assuming an incident response role or responsibility.	The organization conducting the inspection/assessment obtains and examines the documented process as well as training records for a sampling of information system users to ensure the organization being inspected/assessed provides incident response training to information system users consistent with assigned roles and responsibilities within 30 working days of assuming an incident response role or responsibility.	TRUE				X						Non-Designer	---
1220	IR-2	IR-2(b)	CCI-002779	The organization provides incident response training to information system users consistent with assigned roles and responsibilities when required by information system changes.	The organization being inspected/assessed documents and implements a process to provide incident response training to information system users, other than general users, consistent with assigned roles and responsibilities when required by information system changes.	The organization conducting the inspection/assessment obtains and examines the documented process as well as training records for a sampling of information system users to ensure the organization being inspected/assessed provides incident response training to information system users, other than general users, consistent with assigned roles and responsibilities when required by information system changes.	TRUE				X						Non-Designer	---
1221	IR-2	IR-2(c)	CCI-000814	The organization provides refresher incident response training in accordance with organization-defined frequency.	The organization being inspected/assessed documents and implements a process to provide incident response training to information system users, other than general users, consistent with assigned roles and	The organization conducting the inspection/assessment obtains and examines the documented process as well as training records for a sampling of information system users to ensure the organization being inspected/assessed provides incident response training to information system users, other than	TRUE				X						Non-Designer	---
1222	IR-2	IR-2(c)	CCI-000815	The organization defines a frequency for refresher incident response training.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as annually.	TRUE	X									DoD-Defined	---
1231	IR-4	IR-4(a)	CCI-000822	The organization implements an incident handling capability for security incidents that includes preparation, detection and analysis, containment, eradication, and recovery.	The organization being inspected/assessed must have a documented and certified CNDSP and documented procedures for information system users and site security personnel to handle incidents until they are transferred to the responsibility of the CNDSP.	The organization conducting the inspection/assessment obtains and examines the documentation identifying the CNDSP leveraged as well as the documented procedures for incident handling to ensure that there is a certified CNDSP in use and that there are procedures implemented to handle incidents until they are transferred to the responsibility of the CNDSP.	TRUE				X						Non-Designer	---
1232	IR-4	IR-4(b)	CCI-000823	The organization coordinates incident handling activities with contingency planning activities.	The organization being inspected/assessed will coordinate the incident response plan (IR-8) and contingency plan (CP-2) to ensure they allow for an effective transfer of information system activity and maintain confidentiality and integrity of the contingency assets.	The organization conducting the inspection/assessment obtains and examines the incident response plan (IR-8) and contingency plan (CP-2) to ensure they allow for an effective transfer of information system activity and maintain confidentiality and integrity of the contingency assets.	TRUE				X						Non-Designer	---
1233	IR-4	IR-4(c)	CCI-000824	The organization incorporates lessons learned from ongoing incident handling activities into incident response procedures, training, and testing/exercises.	The organization being inspected/assessed will conduct after action reviews from incidents to identify lessons learned and will incorporate them into procedures, training, and testing/exercises. The organization must maintain records of after action reviews.	The organization conducting the inspection/assessment obtains and examines after action reports or meeting minutes to identify actionable lessons learned to verify that lessons learned are incorporated into the plan as changes are necessary.	TRUE				X						Non-Designer	---
1234	IR-4	IR-4(c)	CCI-001625	The organization implements the resulting incident handling activity changes to incident response procedures, training and testing/exercise accordingly.	The organization being inspected/assessed will follow the latest incident response plan (IR-8) that has been revised (based on IR-4, CCI-000824) and disseminated.	The organization conducting the inspection/assessment obtains and examines recent changes to the incident response plan (based on IR-4, CCI 000824) to verify that they have been disseminated and reviews the most recent after action report to ensure that changes have been followed.	TRUE				X						Non-Designer	---
1252	IR-5	IR-5	CCI-000832	The organization tracks and documents information system security incidents.	The organization being inspected/assessed will document within their incident handling plan, procedures to leverage the Joint Incident Management System (JIMS).	The organization conducting the inspection/assessment obtains and examines the incident handling plan to ensure that there are procedures identified to leverage the JIMS.	TRUE				X						Non-Designer	---
1256	IR-6	IR-6(a)	CCI-000834	The organization defines a time period for personnel to report suspected security incidents to the organizational incident response capability.	DoD has defined the time period as the timeframes specified by CJCSM 6510.01B (Table C-A-1) unless the data owner provides more restrictive guidance. If organizations decide to be more restrictive than the guidance in the CJCSM, then they should address the more restrictive response time requirements in their	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as the timeframes specified by CJCSM 6510.01B (Table C-A-1) unless the data owner provides more restrictive guidance.	TRUE	X			X						DoD-Defined Non-Designer	---
1257	IR-6	IR-6(a)	CCI-000835	The organization requires personnel to report suspected security incidents to the organizational incident response capability within the organization-defined time period.	The organization being inspected/assessed documents within the user agreement the requirement for all system users to report suspected security incidents to the organizational incident response capability within the	The organization conducting the inspection/assessment obtains and examines the user agreement to ensure users are required to report suspected security incidents to the organizational incident response capability within the timeframes specified by CJCSM 6510.01B (Table C-A-1) unless the data	TRUE				X						Non-Designer	---
1258	IR-6	IR-6(b)	CCI-000836	The organization reports security incident information to organization-defined authorities.	The organization being inspected/assessed documents and implements a process to report to the appropriate CIRT/CERT (such as US-CERT, DoD CERT, IC CERT) any security incidents IAW the incident response	The organization conducting the inspection/assessment obtains and examines a sample of previous security incidents to ensure the incidents were reported to the appropriate CIRT/CERT (such as US-CERT, DoD CERT, IC CERT).	TRUE				X						Non-Designer	---
1259	IR-6	IR-6(b)	CCI-002791	The organization defines authorities to whom security incident information is reported.	DoD has defined the authorities as the appropriate CIRT/CERT (such as US-CERT, DoD CERT, IC CERT).	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the authorities as the appropriate CIRT/CERT (such as US-	TRUE	X									DoD-Defined	---
1264	IR-7	IR-7	CCI-000839	The organization provides an incident response support resource, integral to the organizational incident response capability, that offers advice and assistance to users of the information system for the handling and reporting of security incidents.	The organization being inspected/assessed will establish an incident response support service, analogous to an IT help desk, to provide advice and assistance to users for handling and reporting of security incidents.	The organization conducting the inspection/assessment will interview organizational users to determine awareness of incident response support services and quality of assistance of those services when used. If interviewing organizational users is not feasible, then review users manuals/documentation to ensure it identifies an incident response support service to contact.	TRUE				X						Non-Designer	---
1268	IR-8	IR-8(a)	CCI-002794	The organization develops an incident response plan.	The organization being inspected/assessed develops and documents an incident response plan.	The organization conducting the inspection/assessment obtains and examines the documented incident response plan to ensure the organization being inspected/assessed develops an incident response plan.	TRUE				X						Non-Designer	---
1269	IR-8	IR-8(a)(1)	CCI-002795	The organization's incident response plan provides the organization with a roadmap for implementing its incident response capability.	The organization being inspected/assessed defines and documents within their incident response plan, a roadmap for implementing its incident response capability.	The organization conducting the inspection/assessment obtains and examines the incident response plan to ensure the organization being inspected/assessed provides within their plan, a roadmap for implementing its incident response capability.	TRUE				X						Non-Designer	---

1270	IR-8	IR-8(a)(2)	CCI-002796	The organization's incident response plan describes the structure and organization of the incident response capability.	The organization being inspected/assessed defines and documents within their incident response plan, the structure and organization of the incident response capability.	The organization conducting the inspection/assessment obtains and examines the incident response plan to ensure the organization being inspected/assessed describes within their plan, the structure and organization of the incident response capability.	TRUE					X					Non-Designer	---
1271	IR-8	IR-8(a)(3)	CCI-002797	The organization's incident response plan provides a high-level approach for how the incident response capability fits into the overall organization.	The organization being inspected/assessed defines and documents within their incident response plan, a high-level approach for how the incident response capability fits into the overall organization.	The organization conducting the inspection/assessment obtains and examines the incident response plan to ensure the organization being inspected/assessed provides within their plan, a high-level approach for how the incident response capability fits into the overall organization.	TRUE					X					Non-Designer	---
1272	IR-8	IR-8(a)(4)	CCI-002798	The organization's incident response plan meets the unique requirements of the organization, which relate to mission, size, structure, and functions.	The organization being inspected/assessed will ensure their incident response plan meets the unique requirements of the organization, which relate to mission, size, structure, and functions.	The organization conducting the inspection/assessment obtains and examines the incident response plan to ensure the organization being inspected/assessed, which relate to mission, size, structure, and functions.	TRUE					X					Non-Designer	---
1273	IR-8	IR-8(a)(5)	CCI-002799	The organization's incident response plan defines reportable incidents.	The organization being inspected/assessed defines and document within their incident response plan, reportable incidents IAW CJCSM 6510.01B Table B-A-2.	The organization conducting the inspection/assessment obtains and examines the incident response plan to ensure the organization being inspected/assessed defines reportable incidents IAW CJCSM 6510.01B Table B-A-2.	TRUE					X					Non-Designer	---
1274	IR-8	IR-8(a)(6)	CCI-002800	The organization's incident response plan provides metrics for measuring the incident response capability within the organization.	The organization being inspected/assessed defines and documents within their incident response plan, metrics for measuring the incident response capability within the organization IAW CJCSM 6510.01B, Enclosure A.	The organization conducting the inspection/assessment obtains and examines the incident response plan to ensure the organization being inspected/assessed defines metrics for measuring the incident response capability within the organization IAW CJCSM 6510.01B, Enclosure A.	TRUE					X					Non-Designer	---
1275	IR-8	IR-8(a)(7)	CCI-002801	The organization's incident response plan defines the resources and management support needed to effectively maintain and mature an incident response capability.	The organization being inspected/assessed defines and documents within their incident response plan, the resources and management support needed to effectively maintain and mature an incident response	The organization conducting the inspection/assessment obtains and examines the incident response plan to ensure the organization being inspected/assessed defines within their plan, the resources and management support needed to effectively maintain and mature an incident response	TRUE					X					Non-Designer	---
1276	IR-8	IR-8(a)(8)	CCI-002802	The organization defines personnel or roles to review and approve the incident response plan.	DoD has defined the personnel or roles as at a minimum, the ISSM and ISSO.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as at a minimum, the ISSM and ISSO.	TRUE	X									DoD-Defined	---
1277	IR-8	IR-8(a)(8)	CCI-000844	The organization develops an incident response plan that is reviewed and approved by organization-defined personnel or roles.	The organization being inspected/assessed will have an incident response plan signed and approved by at a minimum, the ISSM and ISSO. DoD has defined the personnel or roles as at a minimum, the ISSM and ISSO.	The organization conducting the inspection/assessment obtains and examines the incident response plan to validate it has been properly signed by at a minimum, the ISSM and ISSO. DoD has defined the personnel or roles as at a minimum, the ISSM and ISSO.	TRUE					X					Non-Designer	---
1278	IR-8	IR-8(b)	CCI-000845	The organization defines incident response personnel (identified by name and/or by role) and organizational elements to whom copies of the incident response plan is distributed.	DoD has defined the list as all stakeholders identified in the incident response plan.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the list as all stakeholders identified in the incident response plan.	TRUE	X									DoD-Defined	---
1279	IR-8	IR-8(b)	CCI-000846	The organization distributes copies of the incident response plan to organization-defined incident response personnel (identified by name and/or by role) and organizational elements.	The organization being inspected/assessed makes available to all stakeholders identified in the incident response plan via organizationally approved information sharing mechanism. DoD has defined the list as all stakeholders identified in the incident response plan.	The organization conducting the inspection/assessment obtains and examines organizationally approved information sharing mechanism to validate all stakeholders identified in the incident response plan have adequate access to the incident response plan. DoD has defined the list as all stakeholders identified in the incident response plan.	TRUE					X					Non-Designer	---
1280	IR-8	IR-8(c)	CCI-000847	The organization defines the frequency for reviewing the incident response plan.	DoD has defined the frequency as at least annually (incorporating lessons learned from past incidents).	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as at least annually (incorporating lessons learned from past incidents).	TRUE	X									DoD-Defined	---
1281	IR-8	IR-8(c)	CCI-000848	The organization reviews the incident response plan on an organization-defined frequency.	The organization being inspected/assessed will conduct reviews of its incident response plan at least annually. DoD has defined the frequency as at least annually (incorporating lessons learned from past incidents).	The organization conducting the inspection/assessment obtains and examines the incident response plan to validate it is current and has been reviewed within the last year. DoD has defined the frequency as at least annually (incorporating lessons learned from past incidents).	TRUE	X									DoD-Defined	---
1282	IR-8	IR-8(d)	CCI-000849	The organization updates the incident response plan to address system/organizational changes or problems encountered during plan implementation, execution, or testing.	The organization being inspected/assessed must update the incident response plan to address system/organizational changes or problems encountered during plan implementation, execution, or testing and incorporate lessons learned from past incidents (IR-4a). The organization must document the update actions as an audit trail.	The organization conducting the inspection/assessment obtains and examines documentation of the update actions for the incident response plan to ensure the organization is updating the incident response plan to address system/organizational changes or problems encountered during plan implementation, execution, or testing and incorporating lessons learned from past incidents (IR-4a).	TRUE					X					Non-Designer	---
1283	IR-8	IR-8(e)	CCI-002803	The organization defines incident response personnel (identified by name and/or by role) and organizational elements to whom the incident response plan changes will be communicated.	DoD has defined the incident response personnel as all stakeholders identified in the incident response plan, not later than 30 days after the change is made.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the incident response personnel as all stakeholders identified in the incident response plan, not later than 30 days after the change is made.	TRUE	X									DoD-Defined	---
1284	IR-8	IR-8(e)	CCI-000850	The organization communicates incident response plan changes to organization-defined incident response personnel (identified by name and/or by role) and organizational elements.	The organization being inspected/assessed communicates incident response plan changes to all stakeholders identified in the incident response plan, not later than 30 days after the change is made.	The organization conducting the inspection/assessment examines the incident response plan via the inspected organization's information sharing capability (e.g. portal, intranet, email, etc.) to ensure it has been communicated to all stakeholders identified in the incident response plan, not later than 30 days	TRUE					X					Non-Designer	---
1285	IR-8	IR-8(f)	CCI-002804	The organization protects the incident response plan from unauthorized disclosure and modification.	The organization being inspected/assessed protects the incident response plan from unauthorized disclosure and modification.	The organization conducting the inspection/assessment obtains and examines artifacts which identify how the incident response plan is protected to ensure the organization being inspected/assessed protects the incident response plan from unauthorized disclosure and modification.	TRUE					X					Non-Designer	---

1303	MA-1	MA-1(a)	CCI-002861	The organization defines the personnel or roles to whom a system maintenance policy is disseminated.	DoD has defined the personnel or roles as the SCA, ISSO, and maintenance personnel as needed by role in maintaining the system.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as the SCA, ISSO, and maintenance personnel as needed by role in maintaining the system.	TRUE	X									DoD-Defined	---
1304	MA-1	MA-1(a)	CCI-002862	The organization defines the personnel or roles to whom system maintenance procedures are to be disseminated.	DoD has defined the personnel or roles as the SCA, ISSO, and maintenance personnel as needed by role in maintaining the system.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as the SCA, ISSO, and maintenance	TRUE	X									DoD-Defined	---
1305	MA-1	MA-1(a)(1)	CCI-000852	The organization develops and documents a system maintenance policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	The organization being inspected/assessed develops and documents a system maintenance policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among	The organization conducting the inspection/assessment obtains and examines the documented maintenance policy to ensure the organization being inspected/assessed develops and documents a system maintenance policy that addresses purpose, scope, roles, responsibilities, management	TRUE				X						Non-Designer	---
1306	MA-1	MA-1(a)(1)	CCI-000853	The organization disseminates to organization-defined personnel or roles a system maintenance policy.	The organization being inspected/assessed ensures the maintenance policy is disseminated to the SCA, ISSO, and maintenance personnel as needed by role in maintaining the system.	The organization conducting the inspection/assessment obtains and examines the maintenance policy via the inspected organization's information sharing capability (e.g. portal, intranet, email, etc.) to ensure it has been disseminated to the SCA, ISSO, and maintenance personnel as needed by role in	TRUE				X						Non-Designer	---
1307	MA-1	MA-1(a)(2)	CCI-000855	The organization develops and documents procedures to facilitate the implementation of the system maintenance policy and associated system maintenance controls.	The organization being inspected/assessed documents the maintenance procedures within the Security Plan. The maintenance procedures shall be developed IAW maintenance policy provided in DoDI 8500.01..	The organization conducting the inspection/assessment obtains and examines the Security Plan to ensure maintenance procedures are documented and are developed IAW maintenance policy provided in DoDI 8500.01..	TRUE				X						Non-Designer	---
1308	MA-1	MA-1(a)(2)	CCI-000856	The organization disseminates to organization-defined personnel or roles procedures to facilitate the implementation of the system maintenance policy and associated system maintenance controls.	The organization being inspected/assessed ensures the maintenance procedures are disseminated to the SCA, ISSO, and maintenance personnel as needed by role in maintaining the system via an information sharing	The organization conducting the inspection/assessment examines the maintenance procedures via the inspected organization's information sharing capability (e.g. portal, intranet, email, etc.) to ensure it has been disseminated to the SCA, ISSO, and maintenance personnel as needed by role in	TRUE				X						Non-Designer	---
1309	MA-1	MA-1(b)(1)	CCI-000851	The organization defines the frequency to review and update the current system maintenance policy.	DoD has defined the frequency as every 5 years.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as every 5 years.	TRUE	X									DoD-Defined	---
1310	MA-1	MA-1(b)(1)	CCI-000854	The organization reviews and updates the current system maintenance policy in accordance with organization-defined frequency.	The organization being inspected/assessed reviews the current system maintenance policy every 5 years and revises as necessary to comply with DoD regulations.	The organization conducting the inspection/assessment obtains and examines documentation of occurrence of reviews and update actions for the maintenance policy to ensure review is occurring every 5 years and updates are made as necessary.	TRUE				X						Non-Designer	---
1311	MA-1	MA-1(b)(2)	CCI-001628	The organization defines a frequency to review and update the current system maintenance procedures.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as annually.	TRUE				X						Non-Designer	---
1312	MA-1	MA-1(b)(2)	CCI-000857	The organization reviews and updates the current system maintenance procedures in accordance with organization-defined frequency.	The organization being inspected/assessed reviews the current system maintenance procedures annually and revises as needed to comply with DoD regulations. The organization must document each occurrence of the reviews and update actions as an audit trail. DoD has defined the frequency as annually.	The organization conducting the inspection/assessment obtains and examines documentation of occurrence of reviews and update actions for the maintenance procedures to ensure annual review and necessary updates are occurring. DoD has defined the frequency as annually.	TRUE				X						Non-Designer	---
1313	MA-2	MA-2(a)	CCI-002870	The organization schedules repairs on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements	The organization being inspected/assessed schedules repairs on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements. The organization must maintain a record of repairs.	The organization conducting the inspection/assessment obtains and examines the record of repairs to ensure the organization being inspected/assessed schedules repairs on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	TRUE				X						Non-Designer	---
1314	MA-2	MA-2(a)	CCI-002866	The organization schedules maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	The organization being inspected/assessed schedules maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements. The organization must maintain a record of maintenance.	The organization conducting the inspection/assessment obtains and examines the record of maintenance to ensure the organization being inspected/assessed schedules maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	TRUE				X						Non-Designer	---
1315	MA-2	MA-2(a)	CCI-002872	The organization documents repairs on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	The organization being inspected/assessed documents repairs on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	The organization conducting the inspection/assessment obtains and examines documentation of repairs to ensure the organization being inspected/assessed documents repairs on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	TRUE				X						Non-Designer	---
1316	MA-2	MA-2(a)	CCI-002868	The organization documents maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	The organization being inspected/assessed documents maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	The organization conducting the inspection/assessment obtains and examines documentation of maintenance to ensure the organization being inspected/assessed documents maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	TRUE				X						Non-Designer	---
1317	MA-2	MA-2(a)	CCI-002873	The organization reviews records of repairs on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	The organization being inspected/assessed documents and implements a process to review records of repairs on information system components in accordance with manufacturer or vendor specifications and/or	The organization conducting the inspection/assessment obtains and examines the documented process as well as the record of reviews to ensure the organization being inspected/assessed reviews records of repairs on information system components in accordance with manufacturer or vendor	TRUE				X						Non-Designer	---
1318	MA-2	MA-2(a)	CCI-002869	The organization reviews records of maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	The organization being inspected/assessed documents and implements a process to review records of maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements. The organization must maintain a record of reviews.	The organization conducting the inspection/assessment obtains and examines the documented process as well as the record of reviews to ensure the organization being inspected/assessed reviews records of maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	TRUE				X						Non-Designer	---

1319	MA-2	MA-2(a)	CCI-002871	The organization performs repairs on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	The organization being inspected/assessed implements a process to perform repairs on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements. The organization must maintain a record of repair procedures followed.	The organization conducting the inspection/assessment obtains and examines the record of repair procedures followed to ensure the organization being inspected/assessed performs repairs on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	TRUE					X					Non-Designer	---
1320	MA-2	MA-2(a)	CCI-002867	The organization performs maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	The organization being inspected/assessed implements a process to perform maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements. The organization must maintain a record of maintenance procedures followed.	The organization conducting the inspection/assessment obtains and examines the record of maintenance procedures followed to ensure the organization being inspected/assessed performs maintenance on information system components in accordance with manufacturer or vendor specifications and/or organizational requirements.	TRUE					X	X				Non-Designer Impractical	---
1321	MA-2	MA-2(b)	CCI-000859	The organization approves and monitors all maintenance activities, whether performed on site or remotely and whether the equipment is serviced on site or removed to another location.	The organization being inspected/assessed approves and monitors all maintenance activities, whether performed on site or remotely and whether the equipment is serviced on site or removed to another	The organization conducting the inspection/assessment obtains and examines records of all approvals and monitoring activities to ensure the organization being inspected/assessed approves and monitors all maintenance activities whether performed on site or remotely and whether the equipment is serviced	TRUE					X					Non-Designer	---
1322	MA-2	MA-2(c)	CCI-002874	The organization defines the personnel or roles who can explicitly approve the removal of the information system or system components from organizational facilities for off-site maintenance or repairs.	The organization being inspected/assessed defines and documents the personnel or roles who can explicitly approve the removal of the information system or system components from organizational facilities for off-site maintenance or repairs.	The organization conducting the inspection/assessment obtains and examines the documented personnel or roles to ensure the organization being inspected/assessed defines the personnel or roles who can explicitly approve the removal of the information system or system components from organizational facilities for off-site maintenance or repairs.	TRUE					X					Non-Designer	---
1323	MA-2	MA-2(c)	CCI-000860	The organization requires that organization-defined personnel or roles explicitly approve the removal of the information system or system components from organizational facilities for off-site maintenance or repairs.	The organization being inspected/assessed documents within their risk management strategy personnel or roles defined in MA-2, CCI 2874 who must explicitly approve the removal of the information system or system components from organizational facilities for off-site maintenance or repairs.	The organization conducting the inspection/assessment obtains and examines: 1. the organization's risk management strategy to ensure the personnel or roles defined in MA-2, CCI 2874 have been designated to approve the removal of the information system or system components; 2. and written records of approval for the removal of the information system or system components from organizational facilities for off-site maintenance or repairs to ensure the removal is explicitly approved.	TRUE					X					Non-Designer	---
1324	MA-2	MA-2(d)	CCI-000861	The organization sanitizes equipment to remove all information from associated media prior to removal from organizational facilities for off-site maintenance or repairs.	The organization being inspected/assessed sanitizes equipment to remove all information from associated media prior to removal from organizational facilities for off-site maintenance or repairs IAW DoDM 5200.01-V3 for classified media and DoDM 5200.01-V4 for	The organization conducting the inspection/assessment obtains and examines written records of media sanitization to ensure the organization sanitizes equipment to remove all information from associated media prior to removal from organizational facilities for off-site maintenance or repairs.	TRUE					X					Non-Designer	---
1325	MA-2	MA-2(e)	CCI-000862	The organization checks all potentially impacted security controls to verify that the controls are still functioning properly following maintenance or repair actions.	The organization being inspected/assessed identifies and documents the impacted security controls and takes steps to verify that the controls are still functioning properly following maintenance or repair actions.	The organization conducting the inspection/assessment obtains and examines documented evidence of the verification of security controls following maintenance and repair actions to ensure that the organization being inspected/assessed checks all potentially impacted security controls to verify that they are still functioning properly.	TRUE					X	X				Non-Designer Impractical	---
1326	MA-2	MA-2(f)	CCI-002876	The organization defines the maintenance-related information to include in organizational maintenance records.	The organization being inspected/assessed defines and documents the maintenance-related information to include in organizational maintenance records. DoD has determined the maintenance-related	The organization conducting the inspection/assessment obtains and examines the documented maintenance-related information to ensure the organization being inspected/assessed defines the maintenance-related information to include in organizational maintenance records.	TRUE					X					Non-Designer	---
1327	MA-2	MA-2(f)	CCI-002875	The organization includes organization-defined maintenance-related information in organizational maintenance records.	The organization being inspected/assessed includes maintenance-related information defined in MA-2, CCI 2876 in organizational maintenance records.	The organization conducting the inspection/assessment obtains and examines maintenance records to ensure they include maintenance-related information defined in MA-2, CCI 2876.	TRUE					X					Non-Designer	---
1340	MA-4	MA-4(a)	CCI-000873	The organization approves nonlocal maintenance and diagnostic activities.	The organization being inspected/assessed documents the procedures for approving non-local maintenance and diagnostic activities within the Security Plan.	The organization conducting the inspection/assessment obtains and examines: 1. the Security Plan to ensure the procedures for approving non-local maintenance and diagnostic activities are documented; and	TRUE					X					Non-Designer	---
1341	MA-4	MA-4(a)	CCI-000874	The organization monitors nonlocal maintenance and diagnostic activities.	The organization being inspected/assessed develops and implements procedures to monitor non-local maintenance and diagnostic activities. Records of monitoring activity must be maintained.	The organization conducting the inspection/assessment obtains and examines: 1. the Security Plan to identify the authorized non-local maintenance and diagnostic activities; and 2. documented procedures to identify how the use of non-local maintenance	TRUE					X					Non-Designer	---
1342	MA-4	MA-4(b)	CCI-000876	The organization allows the use of nonlocal maintenance and diagnostic tools only as consistent with organizational policy and documented in the security plan for the information system.	The organization being inspected/assessed: 1. documents within the Security Plan the non-local maintenance and diagnostic tools that are allowed; and 2. allows the use of non-local maintenance and diagnostic tools IAW the tools identified in the Security Plan and MA-4, CCI 873.	The organization conducting the inspection/assessment obtains and examines: 1. the Security Plan to ensure non-local maintenance and diagnostic tools have been identified; and 2. maintenance records to ensure only those tools allowed are used IAW MA-4, CCI 873.	TRUE					X					Non-Designer	---
1343	MA-4	MA-4(c)	CCI-000877	The organization employs strong authenticators in the establishment of nonlocal maintenance and diagnostic sessions.	The organization being inspected/assessed configures the information system to employ strong authenticators in the establishment of nonlocal maintenance and diagnostic sessions. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 877.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to employ strong authenticators in the establishment of nonlocal maintenance and diagnostic sessions. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs	TRUE					X	X				Non-Designer Impractical	---
1344	MA-4	MA-4(d)	CCI-000878	The organization maintains records for nonlocal maintenance and diagnostic activities.	The organization being inspected/assessed maintains records of authorized non-local maintenance and diagnostic activities.	The organization conducting the inspection/assessment obtains records of authorized non-local maintenance and diagnostic activities, and examines a sampling to verify the organization is maintaining records for all non-local maintenance and diagnostic activities.	TRUE					X	X				Non-Designer Impractical	---
1345	MA-4	MA-4(e)	CCI-000879	The organization terminates sessions and network connections when nonlocal maintenance is completed.	The organization being inspected/assessed terminates session and network connections when non-local maintenance is completed.	The organization conducting the inspection/assessment obtains and examines audit logs of session and network connections termination for non-local maintenance to ensure session and network connections are terminated when non-local maintenance is completed.	TRUE					X	X				Non-Designer Impractical	---
1363	MA-5	MA-5(a)	CCI-000890	The organization establishes a process for maintenance personnel authorization.	The organization being inspected/assessed clearly defines, documents, and establishes a process for the authorization of maintenance personnel.	The organization conducting the inspection/assessment obtains and examines procedures addressing maintenance personnel to ensure that the organization being inspected/assessed has established processes for the authorization of maintenance personnel.	TRUE					X					Non-Designer	---
1364	MA-5	MA-5(a)	CCI-000891	The organization maintains a list of authorized maintenance organizations or personnel.	The organization being inspected/assessed maintains a current list of authorized maintenance organizations or personnel.	The organization conducting the inspection/assessment obtains and examines the current list of authorized maintenance organizations or personnel to ensure the organization being inspected/assessed is maintaining the list.	TRUE					X					Non-Designer	---
1365	MA-5	MA-5(b)	CCI-002894	The organization ensures that non-escorted personnel performing maintenance on the information system have required access authorizations.	The organization being inspected/assessed documents and implements a process to ensure that non-escorted personnel performing maintenance on the information	The organization conducting the inspection/assessment obtains and examines the documented process as well as the record of personnel performing maintenance on the information system to ensure the organization being	TRUE					X					Non-Designer	---

1386	MA-5	MA-5(c)	CCI-002895	The organization designates organizational personnel with required access authorizations and technical competence to supervise the maintenance activities of personnel who do not have access to the information system media.	The organization being inspected/assessed defines and documents organizational personnel with required access authorizations and technical competence to supervise the maintenance activities of personnel who do not have access to the information system media.	The organization conducting the inspection/assessment obtains and examines documented organizational personnel to ensure the organization being inspected/assessed designates organizational personnel with required access authorizations and technical competence to supervise the maintenance activities of personnel who do not have access to the information system media.	TRUE				X						Non-Designer	---
1386	MP-1	MP-1(a)(1)	CCI-002566	The organization defines personnel or roles to whom a documented media protection policy and procedures will be disseminated.	The organization being inspected/assessed defines and documents organizational personnel with required access authorizations and technical competence to supervise the maintenance activities of personnel who do not have access to the information system media.	The organization conducting the inspection/assessment obtains and examines documented organizational personnel to ensure the organization being inspected/assessed designates organizational personnel with required access authorizations and technical competence to supervise the maintenance activities of personnel who do not have access to the information system media.	TRUE	X	X		X	X					DoD-Defined Enclave Non-Designer Impractical	---
1387	MP-1	MP-1(a)(1)	CCI-000995	The organization develops and documents a media protection policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	TRUE	X	X								DoD-Defined Enclave	---
1388	MP-1	MP-1(a)(1)	CCI-000996	The organization disseminates to organization-defined personnel or roles a media protection policy.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures and is disseminated to all users via http://www.dtic.mil/whs/directives/corres/ins1.html . DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	TRUE		X		X						Enclave Non-Designer	---
1389	MP-1	MP-1(a)(2)	CCI-000999	The organization develops and documents procedures to facilitate the implementation of the media protection policy and associated media protection controls.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	TRUE	X	X								DoD-Defined Enclave	---
1390	MP-1	MP-1(a)(2)	CCI-001000	The organization disseminates to organization-defined personnel or roles procedures to facilitate the implementation of the media protection policy and associated media protection controls.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures and is disseminated to all users via http://www.dtic.mil/whs/directives/corres/ins1.html . DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	TRUE	X	X								DoD-Defined Enclave	---
1391	MP-1	MP-1(b)(1)	CCI-000998	The organization defines a frequency for reviewing and updating the current media protection policy.	DoD has defined the frequency as reviewed annually - updated as appropriate but at least within 10 years of date of issuance.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as reviewed annually - updated as appropriate but at least within 10 years of date of issuance.	TRUE	X	X								DoD-Defined Enclave	---
1392	MP-1	MP-1(b)(1)	CCI-000997	The organization reviews and updates the current media protection policy in accordance with organization-defined frequency.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	TRUE	X	X								DoD-Defined Enclave	---
1393	MP-1	MP-1(b)(2)	CCI-001002	The organization defines a frequency for reviewing and updating the current media protection procedures.	DoD has defined the frequency as reviewed annually - updated as appropriate.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as reviewed annually - updated as appropriate.	TRUE	X	X								DoD-Defined Enclave	---
1394	MP-1	MP-1(b)(2)	CCI-001001	The organization reviews and updates the current media protection procedures in accordance with organization-defined frequency.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	DoDI 5200.01 and DoDM 5200.01 Vol. 1-4 meet the DoD requirements for media protection policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.01 and DoDM 5200.01 Vol. 1-4.	TRUE	X	X								DoD-Defined Enclave	---
1395	MP-2	MP-2	CCI-001003	The organization restricts access to organization-defined types of digital and/or non-digital media to organization-defined personnel or roles.	The organization being inspected/assessed restricts access to all types of digital and/or non-digital media containing information not cleared for public release to the personnel or roles defined in MP-2, CCI 1005.	The organization conducting the inspection/assessment interviews organizational personnel with information system media protection responsibilities to ensure the organization being inspected/assessed restricts access to all types of digital and/or non-digital media containing information not cleared for public release to the personnel or roles defined in MP-2, CCI 1005.	TRUE		X		X						Enclave Non-Designer	---
1396	MP-2	MP-2	CCI-001004	The organization defines types of digital and/or non-digital media for which the organization restricts access.	DoD has defined the types of digital and non-digital media as all types of digital and/or non-digital media containing information not cleared for public release.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the types of digital and non-digital media as all types of digital and/or non-digital media containing information not cleared for public release.	TRUE	X	X								DoD-Defined Enclave	---
1397	MP-2	MP-2	CCI-001005	The organization defines personnel or roles to restrict access to organization-defined types of digital and/or non-digital media.	The organization being inspected/assessed will define and document personnel or roles to restrict access to media IAW DoD 5200.01-M, CTO 10-133, and CTO 08-001.	The organization conducting the inspection/assessment obtains and examines the documented personnel or roles to restrict access to media to ensure the access is granted IAW DoD 5200.01-M, CTO 10-133, and CTO 08-001.	TRUE		X		X						Enclave Non-Designer	---
1416	MP-6	MP-6(a)	CCI-001028	The organization sanitizes organization-defined information system media prior to disposal, release out of organizational control, or release for reuse using organization-defined sanitization techniques and	The organization being inspected/assessed sanitizes all media prior to disposal, release out of organizational control, or release for reuse IAW DoDM 5200.01 Vol. 1-4 using techniques and procedures IAW NIST SP 800-001.	The organization conducting the inspection/assessment obtains and examines media sanitization records, audit records, any other relevant documents or records, and sanitization tools to ensure sanitization is in compliance with DoDM 5200.01 Vol. 1-4 and uses techniques and procedures IAW NIST SP 800-001.	TRUE		X		X						Enclave Non-Designer	---
1417	MP-6	MP-6(a)	CCI-002578	The organization defines information system media to sanitize prior to disposal, release out of organizational control, or release for reuse using organization-defined sanitization techniques and procedures in accordance with applicable federal and organizational standards and policies.	DoD has defined the information system media as all media.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the information system media as all media.	TRUE	X	X								DoD-Defined Enclave	---
1418	MP-6	MP-6(a)	CCI-002579	The organization defines the sanitization techniques and procedures in accordance with applicable federal and organization standards and policies to be used to sanitize organization-defined information system media prior to disposal, release out of organizational control, or release	DoD has defined the sanitization techniques as techniques and procedures IAW NIST SP 800-88.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the sanitization techniques as techniques and procedures IAW NIST SP 800-88.	TRUE	X	X								DoD-Defined Enclave	---
1419	MP-6	MP-6(b)	CCI-002580	The organization employs sanitization mechanisms with the strength and integrity commensurate with the security category or classification of the information.	The organization being inspected/assessed implements sanitization mechanisms with the strength and integrity commensurate with the security category or classification of the information. The organization must maintain an audit trail of sanitization actions.	The organization conducting the inspection/assessment obtains and examines the audit trail of sanitization actions to ensure the organization being inspected/assessed implements sanitization mechanisms with the strength and integrity commensurate with the security category or classification of the information.	TRUE		X		X						Enclave Non-Designer	---

1435	MP-7	MP-7	CCI-002581	The organization defines the types of information system media to restrict or prohibit on organization-defined information systems or system components using organization-defined security safeguards.	The organization being inspected/assessed defines and documents the types of information system media to restrict or prohibit on organization-defined information systems or system components using organization-defined security safeguards.	The organization conducting the inspection/assessment obtains and examines the documented type of information system media to ensure the organization being inspected/assessed defines the types of information system media to restrict or prohibit on organization-defined information systems or system components using organization-defined security safeguards.	TRUE		X		X					Enclave Non-Designer	---
1436	MP-7	MP-7	CCI-002582	The organization defines the information systems or system components to restrict or prohibit the use of organization-defined types of information system media using organization-defined security safeguards.	The organization being inspected/assessed defines and documents the information systems or system components to restrict or prohibit the use of organization-defined types of information system media using organization-defined security safeguards.	The organization conducting the inspection/assessment obtains and examines the documented information systems or system components to ensure the organization being inspected/assessed defines the information systems or system components to restrict or prohibit the use of organization-defined types of information system media using organization-defined security	TRUE		X		X					Enclave Non-Designer	---
1437	MP-7	MP-7	CCI-002583	The organization defines the security safeguards to use for restricting or prohibiting the use of organization-defined types of information system media on organization-defined information systems or system components.	The organization being inspected/assessed defines and documents the security safeguards to use for restricting or prohibiting the use of organization-defined types of information system media on organization-defined information systems or system components. DoD has determined the security safeguards are not	The organization conducting the inspection/assessment obtains and examines the documented security safeguards to ensure the organization being inspected/assessed defines the security safeguards to use for restricting or prohibiting the use of organization-defined types of information system media on organization-defined information systems or system components. DoD has determined the security safeguards are not appropriate to define at	TRUE		X		X					Enclave Non-Designer	---
1438	MP-7	MP-7	CCI-002584	The organization restricts or prohibits the use of organization-defined types of information system media on organization-defined information systems or system components using organization-defined security safeguards.	The organization being inspected/assessed documents and enforces controls for the use of media defined in MP-7, CCI 2581 on systems defined in MP-7, CCI 2582 using security safeguards defined in MP-7, CCI 2583.	The organization conducting the inspection/assessment obtains and examines the documented controls and examines information system procedures associated with the use of media to ensure the organization being inspected/assessed documents and enforces controls for the use of media defined in MP-7, CCI 2581 on systems defined in MP-7, CCI 2582 using security safeguards defined in MP-7, CCI 2583.	TRUE		X		X					Enclave Non-Designer	---
1454	PE-1	PE-1(a)	CCI-002908	The organization defines the personnel or roles to whom a physical and environmental protection policy is disseminated.	DoD has defined the roles as organizational personnel with physical and environmental protection responsibilities.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the roles as organizational personnel with physical and	TRUE	X			X	X				DoD-Defined Non-Designer Impractical	---
1455	PE-1	PE-1(a)	CCI-002909	The organization defines the personnel or roles to whom the physical and environmental protection procedures are disseminated.	DoD has defined the roles as organizational personnel with physical and environmental protection responsibilities. DoD has defined the roles as organizational personnel with physical and environmental protection responsibilities.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the roles as organizational personnel with physical and environmental protection responsibilities.	TRUE	X			X	X				DoD-Defined Non-Designer Impractical	---
1456	PE-1	PE-1(a)(1)	CCI-000904	The organization develops and documents a physical and environment protection policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and	DoDI 5200.08 and DoD 5200.08-R meet the requirement for Physical and Environmental Policy and procedures.	DoDI 5200.08 and DoD 5200.08-R meet the requirement for Physical and Environmental Policy and procedures.	TRUE				X					Non-Designer	---
1457	PE-1	PE-1(a)(1)	CCI-000905	The organization disseminates a physical and environmental protection policy to organization-defined personnel or roles.	DoD disseminates DoDI 5200.08 and DoD 5200.08-R organization-wide via the DoD Issuances website. http://www.dtic.mil/whs/directives/corres/dir.html DoD has defined the personnel or roles as organizational personnel with physical and environmental protection responsibilities.	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDD 5200.08 and DoD 5200.08-R DoD has defined the personnel or roles as organizational personnel with physical and environmental protection responsibilities.	TRUE				X					Non-Designer	---
1458	PE-1	PE-1(a)(2)	CCI-000908	The organization develops and documents procedures to facilitate the implementation of the physical and environmental protection policy and associated physical and environmental protection controls.	DoDI 5200.08 and DoD 5200.08-R meet the requirement for Physical and Environmental Policy and procedures. DoD Components are automatically compliant with this	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.08 and DoD 5200.08-R.	TRUE				X					Non-Designer	---
1459	PE-1	PE-1(a)(2)	CCI-000909	The organization disseminates physical and environmental protection procedures to organization-defined personnel or roles.	DoD disseminates DoDI 5200.08 and DoD 5200.08-R organization-wide via the DoD Issuances website. http://www.dtic.mil/whs/directives/corres/dir.html DoD has defined the personnel or roles as	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDD 5200.08 and DoD 5200.08-R DoD has defined the personnel or roles as organizational personnel with physical and environmental protection responsibilities.	TRUE				X					Non-Designer	---
1460	PE-1	PE-1(b)(1)	CCI-000907	The organization defines the frequency to review and update the physical and environmental protection policy.	DoD has defined the frequency as reviewed annually - updated as appropriate but at least within 10 years of date of issuance.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as reviewed annually - updated as appropriate	TRUE	X								DoD-Defined	---
1461	PE-1	PE-1(b)(1)	CCI-000906	The organization reviews and updates the current physical and environmental protection policy in accordance with organization-defined frequency.	DoDI 5200.08 and DoD 5200.08-R meet the requirement for Physical and Environmental Policy and procedures.	DoDI 5200.08 and DoD 5200.08-R meet the requirement for Physical and Environmental Policy and procedures.	TRUE				X					Non-Designer	---
1462	PE-1	PE-1(b)(2)	CCI-000911	The organization defines the frequency to review and update the physical and environmental protection procedures.	DoD has defined the frequency as reviewed annually - updated as appropriate.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X								DoD-Defined	---
1463	PE-1	PE-1(b)(2)	CCI-000910	The organization reviews and updates the current physical and environmental protection procedures in accordance with organization-defined frequency.	DoDI 5200.08 and DoD 5200.08-R meet the requirement for Physical and Environmental Policy and procedures.	DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDI 5200.08 and DoD 5200.08-R.	TRUE				X					Non-Designer	---
1464	PE-2	PE-2(a)	CCI-000912	The organization develops a list of individuals with authorized access to the facility where the information system resides.	The organization being inspected/assessed will develop and maintain a list of personnel with authorized access to the facilities where information systems reside.	The organization conducting the inspection/assessment obtains and examines the list of personnel with authorized access to facilities where information systems reside to ensure it is current within every 90 days.	TRUE				X	X				Non-Designer Impractical	---
1465	PE-2	PE-2(a)	CCI-002910	The organization approves a list of individuals with authorized access to the facility where the information system resides.	The organization being inspected/assessed formally approves a list of individuals currently authorized to access the facility where the information system resides.	The organization conducting the inspection/assessment obtains and examines the list of individuals currently authorized to access the facility where the information system resides and ensures it is formally approved.	TRUE				X	X				Non-Designer Impractical	---
1466	PE-2	PE-2(a)	CCI-002911	The organization maintains a list of individuals with authorized access to the facility where the information system resides.	The organization being inspected/assessed maintains a list of individuals currently authorized to access the facility where the information system resides.	The organization conducting the inspection/assessment obtains and examines the list of individuals to ensure the organization being inspected/assessed maintains a list of individuals currently authorized to access the facility where the information system resides.	TRUE				X	X				Non-Designer Impractical	---
1467	PE-2	PE-2(b)	CCI-000913	The organization issues authorization credentials for facility access.	The organization being inspected/assessed utilizes the list of personnel with authorized access (IAW PE-2, CCI-000912) and issues credentials accordingly.	The organization conducting the inspection/assessment obtains and examines documentation of credential issuing activities to ensure credentials are issued to personnel with authorized access.	TRUE				X	X				Non-Designer Impractical	---
1468	PE-2	PE-2(c)	CCI-000914	The organization reviews the access list detailing authorized facility access by individuals in accordance with organization-defined frequency.	The organization being inspected/assessed will review the access list and authorization credentials every 90 days and document these review and approval actions as an audit trail.	The organization conducting the inspection/assessment obtains and examines the audit records of the review actions to ensure that reviews are conducted every 90 days.	TRUE				X	X				Non-Designer Impractical	---
1469	PE-2	PE-2(c)	CCI-000915	The organization defines the frequency to review the access list detailing authorized facility access by individuals.	DoD has defined the frequency as every 90 days.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as every 90 days.	TRUE				X	X				Non-Designer Impractical	---
1470	PE-2	PE-2(c)	CCI-001635	The organization removes individuals from the facility access list when access is no longer required.	The organization being inspected/assessed will remove personnel from the authorized access list who no longer have approved access and revoke their credentials, as identified in actions per PE-2, CCI 914.	The organization conducting the inspection/assessment obtains and examines the review and approval actions documentation to ensure that personnel no longer requiring access have been removed from the authorized access list and their credentials have been revoked.	TRUE				X	X				Non-Designer Impractical	---
1476	PE-3	PE-3(a)	CCI-002915	The organization defines the entry/exit points to the facility where the information system resides.	The organization being inspected/assessed defines and documents the entry/exit points to the facility where the information system resides. DoD has determined the entry/exit points are not	The organization conducting the inspection/assessment obtains and examines the documented entry/exit points and inspects the facility to ensure that all entry/exit points are documented. DoD has determined the entry/exit points are not appropriate to define at the	TRUE				X	X				Non-Designer Impractical	---
1477	PE-3	PE-3(a)	CCI-000919	The organization enforces physical access authorizations at organization-defined entry/exit points to the facility where the information system resides.	The organization being inspected/assessed will implement physical access authorizations at entry/exit points defined in PE-3, CCI 2915 and secure those physical access points (i.e. doors and/or windows) that are not intended for normal access.	The organization conducting the inspection/assessment performs a physical inspection of facility entry/exit points defined in PE-3, CCI 2915 to ensure that either physical access authorization controls are in place for those access points considered normal access points or are properly secured. Physical access points that are not documented or are not secured would be a failure of this control.	TRUE				X	X				Non-Designer Impractical	---
1478	PE-3	PE-3(a)(1)	CCI-000920	The organization verifies individual access authorizations before granting access to the facility.	The organization being inspected/assessed verifies and grants access to facilities based upon individual access authorizations.	The organization conducting the inspection/assessment obtains and examines the access authorization list of personnel that have access to the facility (per access list implemented through PE-2, CCI 000912) where the information system resides. Inspect selected facilities to confirm the inspected organization is granting access at all physical access points to only authorized	TRUE				X	X				Non-Designer Impractical	---

	PE-6	PE-6(b)	CCI-000939	The organization reviews physical access logs in accordance with organization-defined frequency.	The organization being inspected/assessed will review physical access logs every 30 days. The organization must document each occurrence the physical access log review, with results of any necessary incident analysis and action taken, as an audit trail for future reference.	The organization conducting the inspection/assessment obtains and examines the inspected organization's physical access logs or records; physical access incident reports; and any other relevant documents or records. The purpose of the reviews is to determine if the organization is conducting reviews of the physical access logs every 30 days. DoD has defined the frequency as every 30 days.	TRUE				X						Non-Designer	---
1521	PE-6	PE-6(b)	CCI-002941	The organization defines events or potential indications of events requiring review of physical access logs.	The organization being inspected/assessed defines and documents events or potential indications of events requiring review of physical access logs. DoD has determined the events or potential indications of events are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented events or potential indications of events to ensure the organization being inspected/assessed defines events or potential indications of events requiring review of physical access logs. DoD has determined the events or potential indications of events are not appropriate to define at the Enterprise level.	TRUE				X	X					Non-Designer Impractical	---
1522	PE-6	PE-6(b)	CCI-002940	The organization reviews physical access logs upon occurrence of organization-defined events or potential indications of events	The organization being inspected/assessed documents and implements a process to review physical access logs upon occurrence of events or potential indications of events defined in PE-6, CCI 2941. The organization must maintain records of reviews.	The organization conducting the inspection/assessment obtains and examines the documented process as well as the records of reviews to ensure the organization being inspected/assessed reviews physical access logs upon occurrence of events or potential indications of events defined in PE-6, CCI 2941.	TRUE				X						Non-Designer	---
1523	PE-6	PE-6(c)	CCI-000941	The organization coordinates results of reviews and investigations with the organizations incident response capability.	The organization being inspected/assessed will coordinate the results of reviews and investigations of physical security incidents with the organization's incident response capability (for physical security incidents).	The organization conducting the inspection/assessment obtains and examines documentation of physical security incidents to ensure coordination with the inspected organization's incident response capability occurred.	TRUE				X						Non-Designer	---
1535	PE-8	PE-8(a)	CCI-002952	The organization defines the time period to maintain visitor access records to the facility where the information system resides.	DoD has defined the time period as at least one year.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as at least one year.	TRUE	X				X					DoD-Defined Impractical	---
1536	PE-8	PE-8(a)	CCI-000947	The organization maintains visitor access records to the facility where the information system resides for organization-defined time period.	The organization being inspected/assessed must maintain visitor access records for their facilities for at least one year. DoD has defined the time period as at least one year.	The organization conducting the inspection/assessment obtains and examines visitor access records to determine if the organization is maintaining visitor access records to the facility where the information system resides for at least one year. DoD has defined the time period as at least one year.	TRUE				X	X					Non-Designer Impractical	---
1537	PE-8	PE-8(b)	CCI-000949	The organization defines the frequency to review the visitor access records for the facility where the information system resides.	DoD has defined the frequency as every 30 days.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as every 30 days.	TRUE	X				X					DoD-Defined Impractical	---
1538	PE-8	PE-8(b)	CCI-000948	The organization reviews visitor access records in accordance with organization-defined frequency.	The organization being inspected/assessed conducts reviews of visitor access records every 30 days and must establish and maintain a documented audit trail within the authorization lifecycle. DoD has defined the frequency as every 30 days.	The organization conducting the inspection/assessment obtains and examines the audit documentation of visitor access record review to ensure the inspected organization is conducting reviews every 30 days. DoD has defined the frequency as every 30 days.	TRUE				X	X					Non-Designer Impractical	---
1554	PE-12	PE-12	CCI-000963	The organization employs and maintains automatic emergency lighting for the information system that activates in the event of a power outage or disruption and that covers emergency exits and evacuation routes within the facility.	The organization being inspected/assessed must install and maintain automatic emergency lighting for the information system that activates in the event of a power outage or disruption and covers emergency exits and evacuation routes within the facility in compliance with established OSHA requirements.	The organization conducting the inspection/assessment conducts visual inspections and interviews physical security personnel to validate the organization is in compliance with established OSHA requirements by employing and maintaining emergency lighting for the information system, the emergency lighting activates in the event of a power outage or disruption, and it covers emergency exits and evacuation routes within the facility	FALSE							X		0	---	
1557	PE-13	PE-13	CCI-000965	The organization employs and maintains fire suppression and detection devices/systems for the information system that are supported by an independent energy source.	The organization being inspected/assessed must implement and maintain fire suppression and detection devices/systems for the information system that are supported by an independent energy source. An independent energy source is some source other	The organization conducting the inspection/assessment will conduct visual observation and interview organizational personnel with responsibilities for fire detection and suppression devices/systems. The purpose of the reviews and interviews is to validate the fire suppression and detection devices/systems for the information system are supported by an independent energy source.	TRUE		X			X					Enclave Impractical	---
1570	PE-14	PE-14(a)	CCI-000971	The organization maintains temperature and humidity levels within the facility where the information system resides at organization-defined acceptable levels.	Humidity controls are not required for general office areas where information system components may be in use and are only required where there are concentrations of information systems such as server farms, mainframes, etc.	The organization conducting the inspection/assessment reviews temperature and humidity controls to validate that they are set within DoD specified guidelines. DoD has defined the acceptable levels as for commercial grade information	TRUE		X			X					Enclave Impractical	---
1571	PE-14	PE-14(a)	CCI-000972	The organization defines acceptable temperature and humidity levels to be maintained within the facility where the information system resides.	DoD has defined the acceptable levels as for commercial grade information systems: 64.4 – 80.6 degrees F; 45% – 60% Relative Humidity; Dew Point 41.9 ° – 59°F; measured at the air intake inlet of the IT equipment casing; for other systems, levels within	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the acceptable levels as for commercial grade information systems: 64.4 – 80.6 degrees F; 45% – 60% Relative Humidity; Dew Point	TRUE	X	X			X					DoD-Defined Enclave Impractical	---
1572	PE-14	PE-14(b)	CCI-000973	The organization monitors temperature and humidity levels in accordance with organization-defined frequency.	The organization being inspected/assessed will maintain an independent monitor device for temperature and humidity levels not located in the immediate vicinity of the controller continuously unless manufacturer specifications allow for a wide enough tolerance that control is not required.	The organization conducting the inspection/assessment will visually observe the inspected organization's independent monitoring device, obtain and examine audit logs, and interview physical security/safety personnel to validate the inspected organization monitors temperature and humidity levels continuously unless manufacturer specifications allow for a wide enough tolerance that control is not required.	TRUE		X			X					Enclave Impractical	---
1573	PE-14	PE-14(b)	CCI-000974	The organization defines a frequency for monitoring temperature and humidity levels.	DoD has defined the frequency as continuously unless manufacturer specifications allow for a wide enough tolerance that control is not required.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as continuously unless manufacturer specifications allow for a wide enough tolerance that control is not required.	TRUE	X	X								DoD-Defined Enclave	---
1576	PE-15	PE-15	CCI-000977	The organization protects the information system from damage resulting from water leakage by providing master shutoff or isolation valves that are accessible.	The organization being inspected/assessed must provide master shutoff valves that are accessible to protect the information system from damage resulting from water leakage.	The organization conducting the inspection/assessment will inspect the master shutoff valves to ensure they are installed and accessible.	TRUE		X			X					Enclave Impractical	---
1577	PE-15	PE-15	CCI-000978	The organization protects the information system from damage resulting from water leakage by providing master shutoff or isolation valves that are working properly.	The organization being inspected/assessed will ensure that master shutoff valves are working properly and have been inspected by the appropriate organization (e.g., fire marshal, department of public works).	The organization conducting the inspection/assessment will visually inspect master shutoff valve inspection documentation (e.g., inspection form, tag attached to valve).	TRUE		X			X					Enclave Impractical	---
1578	PE-15	PE-15	CCI-000979	Key personnel have knowledge of the master water shutoff or isolation valves.	The organization being inspected/assessed will identify and document key personnel and will provide training on the location and procedures for use of master shutoff valves.	The organization conducting the inspection/assessment obtains and examines list of key personnel with knowledge of location and activation procedures for master shutoff valves and any other relevant documents or records. Interview key personnel from the list to determine if identified key personnel within the	TRUE		X			X					Enclave Impractical	---
1581	PE-16	PE-16	CCI-000981	The organization authorizes organization-defined types of information system components entering and exiting the facility.	The organization being inspected/assessed authorizes and maintains authorization records of all system components entering and exiting the facility. DoD has defined the types of information system	The organization conducting the inspection/assessment obtains and examines records authorizing all system components entering and exiting the facility. DoD has defined the types of information system components	TRUE		X		X	X					Enclave Non-Designer Impractical	---

[illegible]

1687	PS-4	PS-4(a)	CCI-001522	The organization, upon termination of individual employment, disables information system access within organization-defined time period.	The organization being inspected/assessed upon termination of individual employment, terminates information system access immediately and IAW organization security policy and procedures. The organization must retain an audit trail of account termination actions (AU-2). DoD has defined the time period as immediately.	The organization conducting the inspection/assessment obtains and examines organizational security policy and procedures documentation and audit records of account termination actions to ensure account termination actions are conducted immediately and IAW organizational security policy and procedures. DoD has defined the time period as immediately.	TRUE				X						Non-Designer	---
1688	PS-4	PS-4(b)	CCI-003023	The organization, upon termination of individual employment, terminates/revokes any authenticators/credentials associated with the individual.	The organization being inspected/assessed documents and implements a process to terminate/ revoke any authenticators/credentials associated with the individual upon termination of individual employment. The organization must maintain records of termination/revocation of any authenticators/credentials.	The organization conducting the inspection/assessment obtains and examines the documented process as well as a sampling of records of termination/revocation of any authenticators/credentials to ensure the organization being inspected/assessed terminates/revokes any authenticators/credentials associated with the individual upon termination of individual employment.	TRUE				X						Non-Designer	---
1689	PS-4	PS-4(c)	CCI-003024	The organization defines information security topics to be discussed while conducting exit interviews.	The organization being inspected/assessed defines and documents information security topics to be discussed while conducting exit interviews. DoD has determined the information security topics are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented information security topics to ensure the organization being inspected/assessed defines information security topics to be discussed while conducting exit interviews. DoD has determined the information security topics are not appropriate to define at the Enterprise level.	TRUE				X						Non-Designer	---
1690	PS-4	PS-4(c)	CCI-001523	The organization, upon termination of individual employment, conducts exit interviews that include a discussion of organization-defined information security topics.	The organization being inspected/assessed, conducts exit interviews that include a discussion of information security topics defined in PS-4, CCI 3024 upon termination of individual employment IAW organization security policy and procedures. The organization must retain an audit trail of conducted exit interviews (AU-2)	The organization conducting the inspection/assessment obtains and examines documentation of departed personnel and the audit trail of conducted exit interviews to ensure all departed personnel had exit interviews conducted that include a discussion of information security topics defined in PS-4, CCI 3024.	TRUE				X						Non-Designer	---
1691	PS-4	PS-4(d)	CCI-001524	The organization, upon termination of individual employment, retrieves all security-related organizational information systems-related property.	The organization being inspected/assessed upon termination of individual employment retrieves all security-related organizational information systems-related property IAW organization security policy and procedures. The organization must retain an audit trail of all retrieved security-related organizational information systems-related property (AU-2).	The organization conducting the inspection/assessment obtains and examines appropriate organization security-related organizational information systems-related property documentation/logs and compares to audit trail of all retrieved security-related organizational information systems-related property (AU-2) to ensure all property has been retrieved.	TRUE				X						Non-Designer	---
1692	PS-4	PS-4(e)	CCI-001525	The organization, upon termination of individual employment, retains access to organizational information formerly controlled by terminated individual.	The organization being inspected/assessed upon termination of individual employment retains access to organizational information formerly controlled by terminated individual IAW organization security policy and procedures. Organizational information formerly controlled by terminated individuals generally refers to online work-	The organization conducting the inspection/assessment interviews appropriate IT and security personnel to validate the organization has procedures in place which, upon termination of individual's employment, will ensure it retains access to organizational information formerly controlled by the terminated individual.	TRUE				X						Non-Designer	---
1693	PS-4	PS-4(e)	CCI-001526	The organization, upon termination of individual employment, retains access to organizational information systems formerly controlled by terminated individual.	The organization being inspected/assessed upon termination of individual employment retains access to organizational information systems formerly controlled by terminated individual IAW organization security policy and procedures. Organizational information systems formerly controlled by terminated individuals generally refers to issued hardware (e.g. laptops, BlackBerrys, PEDs, removable	The organization conducting the inspection/assessment interviews appropriate IT and security personnel to validate the organization has procedures in place which, upon termination of individual's employment, will ensure it retains access to organizational information systems formerly controlled by the terminated individual.	TRUE				X						Non-Designer	---
1694	PS-4	PS-4(f)	CCI-003025	The organization defines personnel or roles to notify upon termination of individual employment.	DoD has defined the personnel or roles as at a minimum, the ISSO and personnel responsible for revoking credentials.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as at a minimum, the ISSO and personnel responsible for revoking credentials.	TRUE	X				X					DoD-Defined Impractical	---
1695	PS-4	PS-4(f)	CCI-003026	The organization defines the time period in which to notify organization-defined personnel or roles upon termination of individual employment.	DoD has defined the time period as immediately or within 24 hours.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as immediately or within 24 hours.	TRUE	X									DoD-Defined	---
1696	PS-4	PS-4(f)	CCI-003016	The organization, upon termination of individual employment, notifies organization-defined personnel or roles within an organization-defined time period.	The organization being inspected/assessed notifies at a minimum, the ISSO and personnel responsible for revoking credentials immediately or within 24 hours upon termination of individual employment.	The organization conducting the inspection/assessment obtains and examines records of termination notification to ensure the organization being inspected/assessed notifies at a minimum, the ISSO and personnel responsible for revoking credentials immediately or within 24 hours upon termination of individual employment.	TRUE	X				X					DoD-Defined Impractical	---

1701	PS-5	PS-5(a)	CCI-001527	The organization reviews and confirms ongoing operational need for current logical and physical access authorizations to information systems/facilities when individuals are reassigned or transferred to other positions within the organization.	The organization being inspected/assessed reviews and confirms ongoing operational need for logical and physical access authorizations to information systems/facilities when individuals are reassigned or transferred to other positions within the organization. The organization must maintain an audit trail of reviews.	The organization conducting the inspection/assessment obtains and examines the audit trail of reviews to ensure that the organization has confirmed the ongoing operational need for logical and physical access authorizations to information systems/facilities when individuals are reassigned or transferred to other positions within the organization.	TRUE				X						Non-Designer	---
1702	PS-5	PS-5(b)	CCI-001528	The organization initiates organization-defined transfer or reassignment actions within an organization-defined time period following the formal personnel transfer action.	The organization being inspected/assessed initiates transfer or reassignment actions to ensure all system accesses no longer required are removed and actions to ensure all system accesses required due to the individual's new position are granted immediately when personnel are reassigned or transferred to other positions. DoD defines transfer or reassignment actions as actions to ensure all system accesses no longer required are removed. DoD defines the time period as immediately.	The organization conducting the inspection/assessment obtains and examines appropriate organization security-related organizational physical and logical access documentation/logs and compares to transferred personnel documentation to ensure appropriate logical and physical access have been revoked for previous positions and granted for new positions immediately. DoD defines the time period as immediately.	TRUE				X						Non-Designer	---
1703	PS-5	PS-5(b)	CCI-001529	The organization defines transfer or reassignment actions to initiate within an organization-defined time period following the formal personnel transfer action.	DoD defines transfer or reassignment actions as actions to ensure all system accesses no longer required are removed.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD defines transfer or reassignment actions as actions to ensure all system accesses no longer required are removed.	TRUE	X									DoD-Defined	---
1704	PS-5	PS-5(b)	CCI-001530	The organization defines the time period within which the organization initiates organization-defined transfer or reassignment actions, following the formal personnel transfer action.	DoD defines the time period as immediately.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD defines the time period as immediately.	TRUE	X									DoD-Defined	---
1705	PS-5	PS-5(c)	CCI-003031	The organization modifies access authorization as needed to correspond with any changes in operational need due to reassignment or transfer.	The organization being inspected/assessed documents and implements a process to modify access authorization as needed to correspond with any changes in operational need due to reassignment or transfer.	The organization conducting the inspection/assessment obtains and examines the documented process and a sampling of accounts of users recently transferred or reassigned to ensure the organization being inspected/assessed modifies access authorization as needed to correspond with any changes in operational need due to reassignment or transfer.	TRUE				X						Non-Designer	---
1706	PS-5	PS-5(d)	CCI-003032	The organization notifies organization-defined personnel or roles within an organization-defined time period when individuals are transferred or reassigned to other positions within the organization.	The organization being inspected/assessed notifies at a minimum, the ISSO and personnel responsible for transferring credentials within 24 hours when individuals are transferred or reassigned to other positions within the organization. The organization must maintain records of transfer/reassignment notifications. DoD has defined the personnel or roles as at a minimum, the ISSO and personnel responsible for	The organization conducting the inspection/assessment obtains and examines records of transfer/reassignment notifications to ensure the organization being inspected/assessed notifies at a minimum, the ISSO and personnel responsible for transferring credentials within 24 hours when individuals are transferred or reassigned to other positions within the organization. DoD has defined the personnel or roles as at a minimum, the ISSO and personnel responsible for transferring credentials. DoD has defined the time period as within 24 hours.	TRUE				X						Non-Designer	---
1707	PS-5	PS-5(d)	CCI-003033	The organization defines personnel or roles to be notified when individuals are transferred or reassigned to other positions within the organization.	DoD has defined the personnel or roles as at a minimum, the ISSO and personnel responsible for transferring credentials.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as at a minimum, the ISSO and personnel responsible for transferring credentials.	TRUE	X									DoD-Defined	---
1708	PS-5	PS-5(d)	CCI-003034	The organization defines the time period within which organization-defined personnel or roles are to be notified when individuals are transferred or reassigned to other positions within the organization.	DoD has defined the time period as immediately.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as immediately.	TRUE	X				X					DoD-Defined Impractical	---
1709	PS-6	PS-6(a)	CCI-003035	The organization develops and documents access agreements for organizational information systems.	The organization being inspected/assessed develops and documents access agreements for organizational information systems.	The organization conducting the inspection/assessment obtains and examines the documented access agreements to ensure the organization being inspected/assessed develops and documents access agreements for organizational information systems.	TRUE				X						Non-Designer	---
1710	PS-6	PS-6(b)	CCI-001533	The organization defines the frequency to review and update the access agreements.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as annually.	TRUE	X									DoD-Defined	---
1711	PS-6	PS-6(b)	CCI-001532	The organization reviews and updates the access agreements in accordance with organization-defined frequency.	The organization being inspected/assessed reviews/updates the access agreements annually of employees who have signed access agreements. The purpose of this review/update is to ensure access agreements are current and departed employees no longer have access agreements. The organization must maintain an audit trail of the review and update activity for review. DoD has defined the frequency as annually.	The organization conducting the inspection/assessment obtains and examines the audit trail to ensure review/update occurred annually and departed employees no longer have valid access agreements.	TRUE				X						Non-Designer	---

1749	RA-3	RA-3(d)	CCI-002371	The organization defines the personnel or roles whom the risk assessment results will be disseminated.	DoD has defined the personnel or roles as the ISSM, ISSO, AO, and PM.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X									DoD-Defined	---
1750	RA-3	RA-3(d)	CCI-002370	The organization disseminates risk assessment results to organization-defined personnel or roles.	The organization being inspected/assessed documents and implements a process to disseminates risk assessment results to the ISSM, ISSO, AO, and PM. DoD has defined the personnel or roles as the ISSM, ISSO, AO, and PM.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed disseminates the risk assessment results to the ISSM, ISSO, AO, and PM.	TRUE				X						Non-Designer	---
1751	RA-3	RA-3(e)	CCI-001052	The organization updates the risk assessment on an organization-defined frequency or whenever there are significant changes to the information system or environment of operation (including the identification of new	The organization being inspected/assessed updates the risk assessment upon re-accreditation or whenever there are significant changes to the information system or environment of operation (including the identification	The organization conducting the inspection/assessment obtains and examines historical versions of the risk assessment as well as records of changes to the system to ensure the organization being inspected/assessed updates the risk assessment upon re-accreditation or whenever there are significant changes	TRUE				X						Non-Designer	---
1752	RA-3	RA-3(e)	CCI-001053	The organization defines a frequency for updating the risk assessment.	DoD has defined the frequency as upon re-accreditation	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X									DoD-Defined	---
1761	RA-5	RA-5(d)	CCI-001060	The organization defines response times for remediating legitimate vulnerabilities in accordance with an organization assessment of risk.	DoD has defined the response times as IAW an authoritative source (e.g. IAVM, CTOs, DTMs).	DoD has defined the frequency as upon re-accreditation.	TRUE	X				X					DoD-Defined Impractical	---
1762	RA-5	RA-5(e)	CCI-002376	The organization defines the personnel or roles whom the information obtained from the vulnerability scanning process and security control assessments will be shared.	DoD has defined the personnel or roles as at a minimum, the ISSO and ISSM.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X									DoD-Defined	---
1763	RA-5	RA-5(e)	CCI-001061	The organization shares information obtained from the vulnerability scanning process and security control assessments with organization-defined personnel or roles to help eliminate similar vulnerabilities in other information	The organization being inspected/assessed documents and implements a process to share information obtained from the vulnerability scanning process and security control assessments with at a minimum, the	DoD has defined the personnel or roles as at a minimum, the ISSO and ISSM.	TRUE				X						Non-Designer	---
1781	SA-1	SA-1(a)	CCI-003089	The organization defines the personnel or roles to whom the system and services acquisition policy is disseminated.	DoD has defined the personnel or roles as all personnel	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X			X	X					DoD-Defined Non-Designer Impractical	---
1782	SA-1	SA-1(a)	CCI-003090	The organization defines the personnel or roles to whom procedures to facilitate the implementation of the system and services acquisition policy and associated system and services acquisition controls are disseminated.	DoD has defined the personnel or roles as all personnel	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X			X	X					DoD-Defined Non-Designer Impractical	---
1783	SA-1	SA-1(a)(1)	CCI-000602	The organization develops and documents a system and services acquisition policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures. DoD Components are automatically compliant with this	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures.	TRUE	X									DoD-Defined	---
1784	SA-1	SA-1(a)(1)	CCI-000603	The organization disseminates to organization-defined personnel or roles a system and services acquisition policy.	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures. DoD Components are automatically compliant with this	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures.	TRUE	X									DoD-Defined	---
1785	SA-1	SA-1(a)(2)	CCI-000605	The organization develops and documents procedures to facilitate the implementation of the system and services acquisition policy and associated system and services acquisition controls.	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies.	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures.	TRUE	X									DoD-Defined	---
1786	SA-1	SA-1(a)(2)	CCI-000606	The organization disseminates to organization-defined personnel or roles procedures to facilitate the implementation of the system and services acquisition policy and associated system and services acquisition controls.	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures. DoD Components are automatically compliant with this	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures.	TRUE	X									DoD-Defined	---
1787	SA-1	SA-1(b)(1)	CCI-000601	The organization defines the frequency to review and update the current system and services acquisition policy.	DoD has defined the frequency as every 5 years.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X									DoD-Defined	---
1788	SA-1	SA-1(b)(1)	CCI-000604	The organization reviews and updates the current system and services acquisition policy in accordance with organization-defined frequency.	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures. DoD Components are automatically compliant with this	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures.	TRUE	X									DoD-Defined	---
1789	SA-1	SA-1(b)(2)	CCI-001646	The organization defines the frequency to review and update the current system and services acquisition procedures.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X									DoD-Defined	---
1790	SA-1	SA-1(b)(2)	CCI-000607	The organization reviews and updates the current system and services acquisition procedures in accordance with organization-defined frequency.	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policies, DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1.	DoDD 5000.01, DoDI 5000.02, and DoDI 8580.1 meet the DoD requirements for system and services acquisition policy and procedures.	TRUE	X									DoD-Defined	---
1791	SA-2	SA-2(a)	CCI-003091	The organization determines information security requirements for the information system or information system service in mission/business process planning.	The organization being inspected/assessed determines and documents information security requirements for the information system or information system service in mission/business process planning.	The organization conducting the inspection/assessment obtains and examines the documented information security requirements to ensure the organization being inspected/assessed determines information security requirements for the information system or information system service in mission/business process planning.	TRUE				X						Non-Designer	---
1792	SA-2	SA-2(b)	CCI-000610	The organization determines the resources required to protect the information system or information system service as part of its capital planning and investment control process.	The organization being inspected/assessed determines the resources (funding, staffing, etc.) required for the cybersecurity requirements to protect the information system or information system service as part of its planning, programming, and budget process (PPBE).	The organization conducting the inspection/assessment obtains and examines the planning, programming, and budget documentation to ensure the organization being inspected/assessed has determined the resources required for cybersecurity requirements to protect the information system or information system service.	TRUE				X						Non-Designer	---
1793	SA-2	SA-2(b)	CCI-000611	The organization documents the resources required to protect the information system or information system service as part of its capital planning and investment control process.	The organization being inspected/assessed documents the resources (funding, staffing, etc.) required for the cybersecurity requirements to protect the information system or information system service as part of its planning, programming, and budget process (PPBE).	The organization conducting the inspection/assessment obtains and examines the planning, programming, and budget documentation to ensure the organization being inspected/assessed has documented the resources required for cybersecurity requirements to protect the information system or information system service.	TRUE				X						Non-Designer	---
1794	SA-2	SA-2(b)	CCI-000612	The organization allocates the resources required to protect the information system or information system service as part of its capital planning and investment control process.	The organization being inspected/assessed allocates the resources (funding, staffing, etc.) required for the cybersecurity requirements to protect the information system or information system service as part of its planning, programming, and budget process (PPBE).	The organization conducting the inspection/assessment obtains and examines the planning, programming, and budget documentation to ensure the organization being inspected/assessed has allocated the resources required for cybersecurity requirements to protect the information system or information system service.	TRUE				X	X					Non-Designer Impractical	---

1795	SA-2	SA-2(c)	CCI-000613	The organization establishes a discrete line item for information security in organizational programming documentation.	The organization being inspected/assessed identifies and establishes an individual line item for cybersecurity requirements to protect the information system as part of the planning, programming, and budget process (PPBE).	The organization conducting the inspection/assessment obtains and examines the planning, programming, and budget documentation to ensure the organization being inspected/assessed has identified and established an individual line item for cybersecurity requirements to protect the information system.	TRUE					X					Non-Designer	---
1796	SA-2	SA-2(c)	CCI-000614	The organization establishes a discrete line item for information security in organizational budgeting documentation.	The organization being inspected/assessed identifies and establishes an individual line item for cybersecurity requirements to protect the information system as part of the planning, programming, and budget process (PPBE).	The organization being inspected/assessed has identified and established an individual line item for cybersecurity requirements to protect the information system.	TRUE					X					Non-Designer	---
1797	SA-3	SA-3(a)	CCI-003092	The organization defines a system development life cycle that is used to manage the information system.	The organization being inspected/assessed defines and documents a system development life cycle that is used to manage the information system. DoD has determined the system development life cycle is not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented system development life cycle to ensure the organization being inspected/assessed defines a system development life cycle that is used to manage the information system. DoD has determined the system development life cycle is not appropriate to	TRUE					X					Non-Designer	---
1798	SA-3	SA-3(a)	CCI-000615	The organization manages the information system using organization-defined system development life cycle that incorporates information security considerations.	The organization being inspected/assessed documents and implements a process to manage the information system using the system development life cycle defined in SA-3, CCI 3092 that incorporates information security considerations IAW DoDI 8580.1.	The organization conducting the inspection/assessment obtains and examines the documented process and artifacts of the system development life cycle process to ensure the organization being inspected/assessed manages the information system using the system development life cycle defined in SA-3, CCI 3092 that incorporates information security considerations IAW DoDI 8580.1.	TRUE					X					Non-Designer	---
1799	SA-3	SA-3(b)	CCI-000616	The organization defines and documents information system security roles and responsibilities throughout the system development life cycle.	The organization being inspected/assessed defines and documents information system security roles and responsibilities throughout the system development life cycle IAW DoDI 8580.1 .	The organization conducting the inspection/assessment obtains and examines the information system security roles and responsibilities to ensure the organization being inspected/assessed defines and documents information system security roles and responsibilities throughout the system development life cycle IAW DoDI 8580.1.	TRUE					X					Non-Designer	---
1800	SA-3	SA-3(c)	CCI-000618	The organization identifies individuals having information system security roles and responsibilities.	The organization being inspected/assessed identifies and documents individuals having information system security roles and responsibilities.	The organization conducting the inspection/assessment obtains and examines the documented individuals having information system security roles and responsibilities to ensure the organization being inspected/assessed identifies individuals having information system security roles and responsibilities.	TRUE					X					Non-Designer	---
1801	SA-3	SA-3(d)	CCI-003093	The organization integrates the organizational information security risk management process into system development life cycle activities.	The organization being inspected/assessed documents and implements a process to integrate the organizational information security risk management process into system development life cycle activities.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed integrates the organizational information security risk management process into system development life cycle activities.	TRUE					X					Non-Designer	---
1802	SA-4	SA-4(a)	CCI-003094	The organization includes the security functional requirements, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service in accordance with applicable federal laws, Executive Orders, directives, policies, regulations, standards, guidelines, and organizational mission/business needs.	The organization being inspected/assessed documents within contracts/agreements for the information system, system component, or information system service, the security functional requirements, explicitly or by reference, IAW DoDI 8580.1.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed includes the security functional requirements, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service in accordance with applicable federal laws, Executive Orders, directives, policies, regulations, standards, guidelines, and organizational mission/business needs including DoDI 8580.1.	TRUE					X	X				Non-Designer Impractical	---
1803	SA-4	SA-4(b)	CCI-003095	The organization includes the security strength requirements, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service in accordance with applicable	The organization being inspected/assessed documents within contracts/agreements for the information system, system component, or information system service, the security strength requirements, explicitly or by	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed includes the security strength requirements, explicitly or by reference, in the acquisition contract for the information system, system component, or	TRUE					X	X				Non-Designer Impractical	---
1804	SA-4	SA-4(c)	CCI-003096	The organization includes the security assurance requirements, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service in accordance with applicable federal laws, Executive Orders, directives, policies, regulations, standards, guidelines, and organizational mission/business needs.	The organization being inspected/assessed documents within contracts/agreements for the information system, system component, or information system service, the security assurance requirements, explicitly or by reference, IAW DoDI 8580.1.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed includes the security assurance requirements, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service in accordance with applicable federal laws, Executive Orders, directives, policies, regulations, standards, guidelines, and organizational mission/business needs including DoDI 8580.1.	TRUE					X	X				Non-Designer Impractical	---
1805	SA-4	SA-4(d)	CCI-003097	The organization includes the security-related documentation requirements, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service in accordance with applicable federal laws, Executive Orders, directives, policies, regulations, standards, guidelines, and organizational mission/business needs.	The organization being inspected/assessed documents within contracts/agreements for the information system, system component, or information system service, the security-related documentation requirements, explicitly or by reference.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed includes the security-related documentation requirements, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service in accordance with applicable federal laws, Executive Orders, directives, policies, regulations, standards, guidelines, and organizational mission/business needs.	TRUE					X	X				Non-Designer Impractical	---
1806	SA-4	SA-4(e)	CCI-003098	The organization includes requirements for protecting security-related documentation, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service in accordance with applicable federal laws, Executive Orders, directives, policies, regulations, standards, guidelines, and organizational mission/business needs.	The organization being inspected/assessed documents within contracts/agreements for the information system, system component, or information system service, requirements for protecting security-related documentation, explicitly or by reference.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed includes requirements for protecting security-related documentation, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service in accordance with applicable federal laws, Executive Orders, directives, policies, regulations, standards, guidelines, and organizational mission/business needs.	TRUE					X	X				Non-Designer Impractical	---
1807	SA-4	SA-4(f)	CCI-003099	The organization includes description of the information system development environment and environment in which the system is intended to operate, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service	The organization being inspected/assessed documents within contracts/agreements for the information system, system component, or information system service, a description of the information system development environment and environment in which the system is	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed includes a description of the information system development environment and environment in which the system is intended to operate, explicitly or by reference, in the acquisition contract for the information system, system	TRUE					X					Non-Designer	---
1808	SA-4	SA-4(g)	CCI-003100	The organization includes acceptance criteria, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service in accordance with applicable federal laws, Executive Orders, directives, policies, regulations, standards,	The organization being inspected/assessed documents within contracts/agreements for the information system, system component, or information system service, acceptance criteria, explicitly or by reference.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed includes acceptance criteria, explicitly or by reference, in the acquisition contract for the information system, system component, or information system service in accordance with applicable federal laws,	TRUE					X	X				Non-Designer Impractical	---
1829	SA-5	SA-5(c)	CCI-000642	The organization documents attempts to obtain information system, system component, or information system service documentation when such documentation is either unavailable or nonexistent.	The organization being inspected/assessed documents attempts to obtain information system, system component, or information system service documentation when such documentation is either unavailable or nonexistent.	The organization conducting the inspection/assessment obtains and examines the documented attempts to ensure the organization being inspected/assessed documents attempts to obtain information system, system component, or information system service documentation when such documentation is either unavailable or nonexistent.	TRUE					X					Non-Designer	---
1830	SA-5	SA-5(c)	CCI-003132	The organization takes organization-defined actions in response to attempts to obtain either unavailable or nonexistent documentation for information system, system component, or information system service.	The organization being inspected/assessed takes actions defined in SA-5, CCI 3133 in response to attempts to obtain either unavailable or nonexistent documentation for information system, system component, or information system service. The organization must maintain a record of actions taken.	The organization conducting the inspection/assessment obtains and examines the record of actions taken to ensure the organization being inspected/assessed takes actions defined in SA-5, CCI 3133 in response to attempts to obtain either unavailable or nonexistent documentation for information system, system component, or information system service. DoD has determined the actions are not appropriate to define at the Enterprise level.	TRUE					X					Non-Designer	---
1831	SA-5	SA-5(c)	CCI-003133	The organization defines actions to be taken in response to attempts to obtain either unavailable or nonexistent documentation for information system, system component, or information system service.	The organization being inspected/assessed defines and documents actions to be taken in response to attempts to obtain either unavailable or nonexistent documentation for information system, system component, or information system service. DoD has determined the actions are not appropriate to define at the Enterprise level.	The organization conducting inspection/assessment obtains and examines the documented actions to ensure the organization being inspected/assessed defines action to be taken in response to attempts to obtain either unavailable or nonexistent documentation for information system, system component, or information system service. DoD has determined the actions are not appropriate to define at the Enterprise level.	TRUE					X					Non-Designer	---

	SC-1	SC-1(a)(1)	CCI-001075	The organization disseminates to organization-defined personnel or roles the system and communications protection policy.	DoDI 8523.01 "Communications Security (COMSEC)"meets the DoD requirement for disseminating the system and communications protection policy. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8523.01.	DoDI 8523.01 "Communications Security (COMSEC)"meets the DoD requirement for disseminating the system and communications protection policy. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8523.01.	TRUE	X								DoD-Defined	---
2113	SC-1	SC-1(a)(2)	CCI-001078	The organization develops and documents system and communications protection procedures to facilitate the implementation of the system and communications protection policy and communications protection controls	DoDI 8523.01 "Communications Security (COMSEC)"meets the DoD requirement for developing system and communications protection procedures.	DoDI 8523.01 "Communications Security (COMSEC)"meets the DoD requirement for developing system and communications protection procedures.	TRUE	X								DoD-Defined	---
2114	SC-1	SC-1(a)(2)	CCI-001079	The organization disseminates to organization-defined personnel or roles the procedures to facilitate the implementation of the system and communications protection policy and associated system and communications protection controls.	DoDI 8523.01 "Communications Security (COMSEC)"meets the DoD requirement for disseminating the procedures to facilitate the implementation of the system and communications protection policy. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8523.01.	DoDI 8523.01 "Communications Security (COMSEC)"meets the DoD requirement for disseminating the procedures to facilitate the implementation of the system and communications protection policy. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8523.01.	TRUE	X								DoD-Defined	---
2115	SC-1	SC-1(b)(1)	CCI-001077	The organization defines the frequency for reviewing and updating the system and communications protection policy.	DoD has defined the frequency as every 5 years.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as every 5 years.	TRUE	X								DoD-Defined	---
2116	SC-1	SC-1(b)(1)	CCI-001076	The organization reviews and updates the system and communications protection policy in accordance with organization-defined frequency.	DoDI 8523.01 "Communications Security (COMSEC)"meets the DoD requirement for reviewing and updating the system and communications protection policy. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8523.01.	DoDI 8523.01 "Communications Security (COMSEC)"meets the DoD requirement for reviewing and updating the system and communications protection policy. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8523.01.	TRUE	X								DoD-Defined	---
2117	SC-1	SC-1(b)(2)	CCI-001081	The organization defines the frequency of system and communications protection procedure reviews and updates.	DoD has defined the frequency as annually.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as annually.	TRUE	X								DoD-Defined	---
2118	SC-1	SC-1(b)(2)	CCI-001080	The organization reviews and updates the system and communications protection procedures in accordance with organization-defined frequency.	DoDI 8523.01 "Communications Security (COMSEC)"meets the DoD requirement for reviewing and updating the system and communications protection procedures.	DoDI 8523.01 "Communications Security (COMSEC)"meets the DoD requirement for reviewing and updating the system and communications protection procedures.	TRUE	X								DoD-Defined	---
2144	SC-7	SC-7(b)	CCI-002395	The information system implements subnetworks for publicly accessible system components that are physically and/or logically separated from internal organizational networks.	The organization being inspected/assessed designs the information system to leverage subnetworks so that publicly accessible system components are physically and/or logically separated from internal organizational networks.	The organization conducting the inspection/assessment obtains and examines network topology diagrams, architecture documentation, or any other documentation identifying component partitioning to ensure the organization being inspected/assessed implements subnetworks for publicly accessible system components that are physically and/or logically separated from internal organizational networks.	FALSE							X	0	---	
2201	SC-12	SC-12	CCI-002428	The organization defines the requirements for cryptographic key generation to be employed within the information system.	DoD has defined the requirements for key generation as requirements for key generation defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the requirements for key generation as requirements for key generation defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE	X	X			X				DoD-Defined Enclave Impractical	---
2202	SC-12	SC-12	CCI-002429	The organization defines the requirements for cryptographic key distribution to be employed within the information system.	DoD has defined the requirements for key distribution as requirements for key distribution defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the requirements for key distribution as requirements for key distribution defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE	X	X			X				DoD-Defined Enclave Impractical	---
2204	SC-12	SC-12	CCI-002431	The organization defines the requirements for cryptographic key access to be employed within the information system.	DoD has defined the requirements for key access as requirements for key access defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the requirements for key access as requirements for key access defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE	X	X			X				DoD-Defined Enclave Impractical	---
2205	SC-12	SC-12	CCI-002432	The organization defines the requirements for cryptographic key destruction to be employed within the information system.	DoD has defined the requirements for key destruction as requirements for key destruction defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the requirements for key destruction as requirements for key destruction defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE	X	X			X				DoD-Defined Enclave Impractical	---
2206	SC-12	SC-12	CCI-002433	The organization establishes cryptographic keys for required cryptography employed within the information system in accordance with organization-defined requirements for key generation.	The organization being inspected/assessed documents and implements a process to establish cryptographic keys for required cryptography employed within the information system in accordance with requirements for key generation defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems." DoD has defined the requirements for key generation as requirements for key generation defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed establishes cryptographic keys for required cryptography employed within the information system in accordance with requirements for key generation defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems." DoD has defined the requirements for key generation as requirements for key generation defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE				X				Non-Designer	---	
2207	SC-12	SC-12	CCI-002434	The organization establishes cryptographic keys for required cryptography employed within the information system in accordance with organization-defined requirements for key distribution.	The organization being inspected/assessed documents and implements a process to establish cryptographic keys for required cryptography employed within the information system in accordance with requirements for key distribution	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed establishes cryptographic keys for required cryptography employed within the information system in accordance with requirements for key distribution	TRUE					X			Non-Designer	---	

	SC-12	SC-12	CCI-002435	The organization establishes cryptographic keys for required cryptography employed within the information system in accordance with organization-defined requirements for key storage.	The organization being inspected/assessed documents and implements a process to establish cryptographic keys for required cryptography employed within the information system in accordance with requirements for key access defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed establishes cryptographic keys for required cryptography employed within the information system in accordance with requirements for key storage defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE					X					Non-Designer	---
2209	SC-12	SC-12	CCI-002436	The organization establishes cryptographic keys for required cryptography employed within the information system in accordance with organization-defined requirements for key access.	The organization being inspected/assessed documents and implements a process to establish cryptographic keys for required cryptography employed within the information system in accordance with requirements for key access defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed establishes cryptographic keys for required cryptography employed within the information system in accordance with requirements for key access defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE					X					Non-Designer	---
2210	SC-12	SC-12	CCI-002437	The organization establishes cryptographic keys for required cryptography employed within the information system in accordance with organization-defined requirements for key destruction.	The organization being inspected/assessed documents and implements a process to establish cryptographic keys for required cryptography employed within the information system in accordance with requirements for key destruction defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed establishes cryptographic keys for required cryptography employed within the information system in accordance with requirements for key destruction defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE					X					Non-Designer	---
2211	SC-12	SC-12	CCI-002438	The organization manages cryptographic keys for required cryptography employed within the information system in accordance with organization-defined requirements for key generation.	The organization being inspected/assessed documents and implements a process to manage cryptographic keys for required cryptography employed within the information system in accordance with requirements for key distribution defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed manages cryptographic keys for required cryptography employed within the information system in accordance with requirements for key distribution defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE					X					Non-Designer	---
2212	SC-12	SC-12	CCI-002439	The organization manages cryptographic keys for required cryptography employed within the information system in accordance with organization-defined requirements for key distribution.	The organization being inspected/assessed documents and implements a process to manage cryptographic keys for required cryptography employed within the information system in accordance with requirements for key distribution defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed manages cryptographic keys for required cryptography employed within the information system in accordance with requirements for key distribution defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE					X					Non-Designer	---
2213	SC-12	SC-12	CCI-002440	The organization manages cryptographic keys for required cryptography employed within the information system in accordance with organization-defined requirements for key storage.	The organization being inspected/assessed documents and implements a process to manage cryptographic keys for required cryptography employed within the information system in accordance with requirements for key storage defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed manages cryptographic keys for required cryptography employed within the information system in accordance with requirements for key storage defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE					X					Non-Designer	---
2214	SC-12	SC-12	CCI-002441	The organization manages cryptographic keys for required cryptography employed within the information system in accordance with organization-defined requirements for key access.	The organization being inspected/assessed documents and implements a process to manage cryptographic keys for required cryptography employed within the information system in accordance with requirements for key access defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed manages cryptographic keys for required cryptography employed within the information system in accordance with requirements for key access defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE					X					Non-Designer	---
2215	SC-12	SC-12	CCI-002442	The organization manages cryptographic keys for required cryptography employed within the information system in accordance with organization-defined requirements for key destruction.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed manages cryptographic keys for required cryptography employed within the information system in accordance with requirements for key destruction defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	The organization being inspected/assessed documents and implements a process to manage cryptographic keys for required cryptography employed within the information system in accordance with requirements for key destruction defined in DoDI 8520.02 "Public Key Infrastructure and Public Key Enabling" and DoDI 8520.03 "Identity Authentication for Information Systems."	TRUE					X					Non-Designer	---
2226	SC-15	SC-15(a)	CCI-001151	The organization defines exceptions to the prohibiting of collaborative computing devices where remote activation is to be allowed.	DoD has defined the exceptions as dedicated VTC suites located in approved VTC locations that are centrally managed.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X	X			X					DoD-Defined Enclave Impractical	---
2267	SC-20	SC-20(a)	CCI-001178	The information system provides additional data origin authentication artifacts along with the authoritative name resolution data the system returns in response to external name/address resolution queries.	The organization being inspected/assessed configures the authoritative name server software for external queries to enable DNSSEC and creates resource records with digital signatures (RRSig) for each A record.	The organization conducting the inspection/assessment: 1. inspects the configuration files for the presence of DNSSEC records for each A record hosted in a zone; 2. utilizes DNSSEC diagnostic tools, such as dig; and 3. performs queries which will exercise the data flow path for authoritative name resolution services.	FALSE							X		0	---	
2268	SC-20	SC-20(a)	CCI-002462	The information system provides additional integrity verification artifacts along with the authoritative name resolution data the system returns in response to external name/address resolution queries.	The organization being inspected/assessed configures the authoritative name server software for external queries to enable DNSSEC and creates resource records with digital signatures (RRSig) for each A record.	The organization conducting the inspection/assessment: 1. inspects the configuration files for the presence of DNSSEC records for each A record hosted in a zone; 2. utilizes DNSSEC diagnostic tools, such as dig; and 3. performs queries which will exercise the data flow path for authoritative name resolution services.	FALSE							X		0	---	
2269	SC-20	SC-20(b)	CCI-001179	The information system, when operating as part of a distributed, hierarchical namespace, provides the means to indicate the security status of child zones.	The organization being inspected/assessed configures the authoritative name server software to enable DNSSEC and creates delegation signer (DS) resource records for each child zone and place those records in the parent zone.	The organization conducting the inspection/assessment inspect the configuration files for the presence of Delegation Signer (DS) Records for any child domains.	FALSE							X		0	---	
2270	SC-20	SC-20(b)	CCI-001663	The information system, when operating as part of a distributed, hierarchical namespace, provides the means to enable verification of a chain of trust among parent and child domains (if the child supports secure resolution services).	The organization being inspected/assessed installs and utilizes software capable of validating the chain of trust (Examples of software include dig, dnsviz, dnsec-debugger, dnsec validator for Mozilla, etc.).	The organization conducting the inspection/assessment utilizes DNSSEC diagnostic tools, such as dig, and performs queries which will exercise the data flow path for authoritative name resolution services where parent and child domains exist.	FALSE							X		0	---	
2273	SC-21	SC-21	CCI-002465	The information system requests data origin authentication verification on the name/address resolution responses the system receives from authoritative sources.	The organization being inspected/assessed configures the: 1. recursive/caching name server software to enable DNSSEC; 2. software to enable DNSSEC validation; and 3. software to establish a secure entry point trust anchor by installing key signing keys in the software	The organization conducting the inspection/assessment utilizes DNSSEC diagnostic tools, such as dig, and performs queries which will exercise the data flow path for recursive name resolution services.	TRUE		X			X					Enclave Impractical	---
2274	SC-21	SC-21	CCI-002466	The information system requests data integrity verification on the name/address resolution responses the system receives from authoritative sources.	The organization being inspected/assessed configures the: 1. recursive/caching name server software to enable DNSSEC; 2. software to enable DNSSEC validation; and 3. software to establish a secure entry point trust anchor by installing key signing keys in the software configuration of trusted keys.	The organization conducting the inspection/assessment utilizes DNSSEC diagnostic tools, such as dig, and performs queries which will exercise the data flow path for recursive name resolution services.	TRUE		X			X					Enclave Impractical	---

	SC-21	SC-21	CCI-002467	The information system performs data integrity verification on the name/address resolution responses the system receives from authoritative sources.	The organization being inspected/assessed configures the: 1. recursive/caching name server software to enable DNSSEC; 2. software to enable DNSSEC validation; and 3. software to establish a secure entry point trust anchor by installing key signing keys in the software configuration of trusted keys. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that determines the name server software configuration files and pertains to CCI 2467.	The organization conducting the inspection/assessment utilizes DNSSEC diagnostic tools, such as dig, and performs queries which will exercise the data flow path for recursive name resolution services. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs that determine the name server software configuration files and pertain to CCI 2467.	TRUE		X				X				Enclave Impractical	---
2276	SC-21	SC-21	CCI-002468	The information system performs data origin verification authentication on the name/address resolution responses the system receives from authoritative sources.	The organization being inspected/assessed configures the: 1. recursive/caching name server software to enable DNSSEC; 2. software to enable DNSSEC validation; and 3. software to establish a secure entry point trust anchor	The organization conducting the inspection/assessment utilizes DNSSEC diagnostic tools, such as dig, and performs queries which will exercise the data flow path for recursive name resolution services. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components	TRUE		X				X				Enclave Impractical	---
2277	SC-22	SC-22	CCI-001182	The information systems that collectively provide name/address resolution service for an organization are fault-tolerant.	The organization being inspected/assessed implements a name service resolution architecture consisting of primary and secondary servers. The organization must document the architecture in the site security plan.	The organization conducting the inspection/assessment reviews the sites implementation documentation of the name resolution servers and verifies primary and alternate services are available. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components	FALSE							X		0	---	
2278	SC-22	SC-22	CCI-001183	The information systems that collectively provide name/address resolution service for an organization implement internal/external role separation.	The organization being inspected/assessed implements a name service resolution architecture where recursive and authoritative server software is not installed on the	The organization conducting the inspection/assessment reviews the sites implementation documentation of the name resolution servers and verifies authoritative and recursive services are not hosted on the same information	FALSE							X		0	---	
2403	SI-1	SI-1(a)	CCI-002601	The organization defines the personnel or roles to whom the system and information integrity policy and procedures are to be disseminated.	DoD has defined the personnel or roles as all appointed information assurance personnel.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as all appointed information assurance personnel.	TRUE	X									DoD-Defined	---
2404	SI-1	SI-1(a)(1)	CCI-001217	The organization develops and documents a system and information integrity policy that addresses purpose, scope, roles, responsibilities, management commitment, coordination among organizational entities, and compliance.	Documenting and implementing the Risk Management Framework (RMF) for DoD IT (DoDI 8510.01) meets the DoD requirement for a system and information integrity policy. DoD Components are automatically compliant with this	Documenting and implementing the Risk Management Framework (RMF) for DoD IT (DoDI 8510.01) meets the DoD requirement for a system and information integrity policy. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, Risk Management Framework (RMF) for DoD	TRUE	X									DoD-Defined	---
2405	SI-1	SI-1(a)(1)	CCI-001218	The organization disseminates the system and information integrity policy to organization-defined personnel or roles.	DoD disseminates DoDI 8510.01 via the DoD Issuances website (http://www.dtic.mil/whs/directives/corres/dir.html) that meets the DoD requirement for a system and information integrity policy.	Documenting and implementing the Risk Management Framework (RMF) for DoD IT (DoDI 8510.01) meets the DoD requirement for a system and information integrity policy. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, Risk Management Framework (RMF) for DoD	TRUE				X						Non-Designer	---
2406	SI-1	SI-1(a)(2)	CCI-001220	The organization develops and documents procedures to facilitate the implementation of the system and information integrity policy and associated system integrity controls.	Documenting and implementing the Risk Management Framework (RMF) for DoD IT (DoDI 8510.01) meets the DoD requirement for a system and information integrity procedures. DoD Components are automatically compliant with this	Documenting and implementing the Risk Management Framework (RMF) for DoD IT (DoDI 8510.01) meets the DoD requirement for a system and information integrity procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, Risk Management Framework (RMF) for DoD	TRUE	X									DoD-Defined	---
2407	SI-1	SI-1(a)(2)	CCI-001221	The organization disseminates to organization-defined personnel or roles procedures to facilitate the implementation of the system and information integrity policy and associated system integrity controls.	DoD disseminates DoDI 8510.01 via the DoD Issuances website (http://www.dtic.mil/whs/directives/corres/dir.html) that meets the DoD requirement for a system and	Documenting and implementing the Risk Management Framework (RMF) for DoD IT (DoDI 8510.01) meets the DoD requirement for a system and information integrity procedures.	TRUE	X									DoD-Defined	---
2408	SI-1	SI-1(b)(1)	CCI-001223	The organization defines the frequency of system and information integrity policy reviews and updates.	DoD has defined the frequency as reviewed annually - updated as appropriate but at least within 10.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as reviewed annually - updated as appropriate but at least within 10.	TRUE	X									DoD-Defined	---
2409	SI-1	SI-1(b)(1)	CCI-001219	The organization reviews and updates system and information integrity policy in accordance with organization-defined frequency.	Documenting and implementing the Risk Management Framework (RMF) for DoD IT (DoDI 8510.01) meets the DoD requirement for a system and information integrity policy. DoD Components are automatically compliant with this	Documenting and implementing the Risk Management Framework (RMF) for DoD IT (DoDI 8510.01) meets the DoD requirement for a system and information integrity policy. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, Risk Management Framework (RMF) for DoD	TRUE	X									DoD-Defined	---
2410	SI-1	SI-1(b)(2)	CCI-001224	The organization defines the frequency of system and information integrity procedure reviews and updates	DoD has defined the frequency as reviewed annually - updated as appropriate.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as reviewed annually - updated as appropriate.	TRUE	X									DoD-Defined	---
2411	SI-1	SI-1(b)(2)	CCI-001222	The organization reviews and updates system and information integrity procedures in accordance with organization-defined frequency.	Documenting and implementing the Risk Management Framework (RMF) for DoD IT (DoDI 8510.01) meets the DoD requirement for a system and information integrity procedures. DoD Components are automatically compliant with this	Documenting and implementing the Risk Management Framework (RMF) for DoD IT (DoDI 8510.01) meets the DoD requirement for a system and information integrity procedures. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, Risk Management Framework (RMF) for DoD	TRUE	X									DoD-Defined	---
2412	SI-2	SI-2(a)	CCI-001225	The organization identifies information system flaws.	The organization being inspected/assessed documents and implements a process to identify information system flaws. The process shall include review of the system through automated scans and manual checks to determine the	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed identifies information system flaws.	TRUE				X						Non-Designer	---
2413	SI-2	SI-2(a)	CCI-001226	The organization reports information system flaws.	The organization being inspected/assessed reports information system flaws according to DoD Cybersecurity policy and organizational roles and responsibilities. The organization must report information system flaws in their POA&M.	The organization conducting the inspection/assessment obtains and examines the authorization package, verifies the POA&M is up to date and includes recently identified information system flaws, and verifies that the organization has notified appropriate personnel as defined by DoD Cybersecurity policy and organizational roles and responsibilities.	TRUE				X						Non-Designer	---
2414	SI-2	SI-2(b)	CCI-001228	The organization tests software updates related to flaw remediation for effectiveness before installation.	The organization being inspected/assessed documents and implements a process to test software updates related to flaw remediation for effectiveness before installation. If the software update is being provided by a vendor who has documented the effectiveness of the update in fixing the affected IAVM/CVE, further testing by the organization may not be required.	The organization conducting the inspection/assessment obtains and examines the documented process and test results to ensure the organization being inspected/assessed tests software updates related to flaw remediation for effectiveness before installation.	TRUE		X		X						Enclave Non-Designer	---

2415	SI-2	SI-2(b)	CCI-001229	The organization tests software updates related to flaw remediation for potential side effects before installation.	The organization being inspected/assessed documents and implements a process for regression testing IAW CM-4.4 to identify any potential side effects before installation of software updates.	The organization conducting the inspection/assessment obtains and examines the documented process and test results to ensure the organization being inspected/assessed tests software updates related to flaw remediation for potential side effects before installation.	TRUE		X		X					Enclave Non-Designer	---
2416	SI-2	SI-2(b)	CCI-002602	The organization tests firmware updates related to flaw remediation for effectiveness before installation.	The organization being inspected/assessed documents and implements a process to test firmware updates related to flaw remediation for effectiveness before installation. If the firmware update is being provided by a vendor who has documented the effectiveness of the update in fixing the affected IAVM/CVE, further testing by the organization may not be required.	The organization conducting the inspection/assessment obtains and examines the documented process and test results to ensure the organization being inspected/assessed tests firmware updates related to flaw remediation for effectiveness before installation.	TRUE		X		X					Enclave Non-Designer	---
2417	SI-2	SI-2(b)	CCI-002603	The organization tests firmware updates related to flaw remediation for potential side effects before installation.	The organization being inspected/assessed documents and implements a process for regression testing IAW CM-4 to identify any potential side effects before installation of software updates.	The organization conducting the inspection/assessment obtains and examines the documented process and test results to ensure the organization being inspected/assessed tests firmware updates related to flaw remediation for potential side effects before installation.	TRUE		X		X					Enclave Non-Designer	---
2418	SI-2	SI-2(c)	CCI-002604	The organization defines the time period within the release of updates that security-related software updates are to be installed.	DoD has defined the time period as 30 days.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as 30 days	TRUE	X				X				DoD-Defined Impractical	---
2419	SI-2	SI-2(c)	CCI-002606	The organization defines the time period within the release of updates that security-related firmware updates are to be installed.	DoD has defined the time period as 30 days.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as 30 days	TRUE	X				X				DoD-Defined Impractical	---
2420	SI-2	SI-2(c)	CCI-002607	The organization installs security-relevant firmware updates within organization-defined time period of the release of the updates	The organization being inspected/assessed configures the information system to install security-relevant firmware updates within 30 days of the release of the updates.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to install security-relevant firmware updates within 30 days of the release of the updates.	TRUE				X					Non-Designer	---
2421	SI-2	SI-2(d)	CCI-001230	The organization incorporates flaw remediation into the organizational configuration management process.	The organization being inspected/assessed documents within their configuration management plan, flaw remediation processes.	The organization conducting the inspection/assessment obtains and examines the configuration management plan to ensure that it incorporates flaw remediation.	TRUE				X					Non-Designer	---
2440	SI-3	SI-3(a)	CCI-002619	The organization employs malicious code protection mechanisms at information system entry points to detect malicious code.	The organization being inspected/assessed identifies and documents the information system entry points and implements malicious code protection mechanisms at those entry points to detect malicious code. Information system entry and exit points include, for example, firewalls, electronic mail servers, web servers, proxy servers, remote-access servers, workstations,	The organization conducting the inspection/assessment examines the information system architecture as well as the organization's documentation of information system entry points and verifies that malicious code protection mechanisms are implemented.	TRUE		X							Enclave	---
2441	SI-3	SI-3(a)	CCI-002621	The organization employs malicious code protection mechanisms at information system entry points to eradicate malicious code.	The organization being inspected/assessed configures the malicious code protection mechanisms identified in SI-3, CCI 2619 to eradicate malicious code.	The organization conducting the inspection/assessment examines the information system architecture as well as the organization's documentation of information system entry points and verifies that malicious code protection mechanisms are implemented to eradicate malicious code.	TRUE		X							Enclave	---
2442	SI-3	SI-3(a)	CCI-002620	The organization employs malicious code protection mechanisms at information system exit points to detect malicious code.	The organization being inspected/assessed identifies and documents the information system exit points and implements malicious code protection mechanisms at those exit points to detect malicious code. Information system entry and exit points include, for example, firewalls, electronic mail servers, web servers, proxy servers, remote-access servers, workstations,	The organization conducting the inspection/assessment examines the information system architecture as well as the organization's documentation of information system exit points and verifies that malicious code protection mechanisms are implemented.	TRUE		X							Enclave	---
2443	SI-3	SI-3(a)	CCI-002622	The organization employs malicious code protection mechanisms at information system exit points to eradicate malicious code.	The organization being inspected/assessed configures the malicious code protection mechanisms identified in SI-3, CCI 2620 to eradicate malicious code.	The organization conducting the inspection/assessment examines the information system architecture as well as the organization's documentation of information system exit points and verifies that malicious code protection mechanisms are implemented to eradicate malicious code.	TRUE		X							Enclave	---
2444	SI-3	SI-3(b)	CCI-001240	The organization updates malicious code protection mechanisms whenever new releases are available in accordance with organizational configuration management policy and procedures.	The organization being inspected/assessed configures the information system to update malicious code protection mechanisms whenever new releases are available in accordance with organizational configuration management policy and procedures. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1240.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to update malicious code protection mechanisms whenever new releases are available in accordance with organizational configuration management policy and procedures. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 1240.	TRUE				X					Non-Designer	---
2447	SI-3	SI-3(c)(1)	CCI-002624	The organization configures malicious code protection mechanisms to perform real-time scans of files from external sources at network entry/exit points as the files are downloaded, opened, or executed in accordance with organizational security policy.	The organization being inspected/assessed configures the malicious code protection mechanisms to perform real-time scans of files from external sources at network entry/exit points as the files are downloaded, opened, or executed in accordance with organizational security	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures malicious code protection mechanisms to perform real-time scans of files from external sources at network entry/exit points as the files are downloaded, opened, or executed in accordance with organizational security	TRUE		X							Enclave	---
2448	SI-3	SI-3(c)(1)	CCI-001242	The organization configures malicious code protection mechanisms to perform real-time scans of files from external sources at endpoints as the files are downloaded, opened, or executed in accordance with organizational security policy.	The organization being inspected/assessed configures malicious code protection mechanisms to perform real-time scans of files from external sources at endpoints as the files are downloaded, opened, or executed in accordance with organizational security policy. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1242.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures malicious code protection mechanisms to perform real-time scans of files from external sources at endpoints as the files are downloaded, opened, or executed in accordance with organizational security policy. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs	TRUE		X							Enclave	---
2449	SI-3	SI-3(c)(2)	CCI-001244	The organization defines one or more actions to perform in response to malicious code detection, such as blocking malicious code, quarantining malicious code, or sending alert to administrator.	DoD has defined the actions as block and quarantine malicious code and then send an alert to the administrator immediately in near real-time.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the actions as block and quarantine malicious code and then send an alert to the administrator immediately in near real-time.	TRUE		X		X					Enclave Non-Designer	---
2450	SI-3	SI-3(c)(2)	CCI-001243	The organization configures malicious code protection mechanisms to perform organization-defined action(s) in response to malicious code detection.	The organization being inspected/assessed configures malicious code protection mechanisms to perform block and quarantine malicious code and then send an alert to the administrator immediately in near real-time in	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures malicious code protection mechanisms to perform block and quarantine malicious code and then send an alert to the administrator	TRUE		X		X					Enclave Non-Designer	---
2451	SI-3	SI-3(d)	CCI-001245	The organization addresses the receipt of false positives during malicious code detection and eradication, and the resulting potential impact on the availability of the information system.	The organization being inspected/assessed configures the information system to address the receipt of false positives during malicious code detection and eradication, and the resulting potential impact on the	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to address the receipt of false positives during malicious code detection and eradication, and the resulting potential	TRUE				X					Non-Designer	---

2474	SI-4	SI-4(a)(1)	CCI-002641	The organization monitors the information system to detect attacks and indicators of potential attacks in accordance with organization-defined monitoring objectives.	The organization being inspected/assessed documents and implements a process to monitor the information system to detect attacks and indicators of potential attacks in accordance with sensor placement and monitoring requirements within CJCSI 6510.01F.	The organization conducting the inspection/assessment obtains and examines the documented process as well as the audit trail of monitoring to ensure the organization being inspected/assessed monitors the information system to detect attacks and indicators of potential attacks in accordance with sensor placement and monitoring requirements within CJCSI 6510.01F.	TRUE		X		X					Enclave Non-Designer	---
2475	SI-4	SI-4(a)(2)	CCI-002642	The organization monitors the information system to detect unauthorized local connections.	The organization being inspected/assessed documents and implements a process to monitor information system to detect unauthorized local connections. The organization must maintain an audit trail of monitoring.	The organization conducting the inspection/assessment obtains and examines the documented process as well as the audit trail of monitoring to ensure the organization being inspected/assessed monitors the information system to detect unauthorized local connections.	TRUE		X		X					Enclave Non-Designer	---
2476	SI-4	SI-4(a)(2)	CCI-002643	The organization monitors the information system to detect unauthorized network connections.	The organization being inspected/assessed documents and implements a process to monitor the information system to detect unauthorized network connections.	The organization conducting the inspection/assessment obtains and examines the documented process as well as the audit trail of monitoring to ensure the organization being inspected/assessed monitors the information system to detect unauthorized network connections.	TRUE		X		X					Enclave Non-Designer	---
2477	SI-4	SI-4(a)(2)	CCI-002644	The organization monitors the information system to detect unauthorized remote connections.	The organization being inspected/assessed documents and implements a process to monitor information system to detect unauthorized remote connections. The organization must maintain an audit trail of monitoring.	The organization conducting the inspection/assessment obtains and examines the documented process as well as the audit trail of monitoring to ensure the organization being inspected/assessed monitors the information system to detect unauthorized remote connections.	TRUE		X		X					Enclave Non-Designer	---
2479	SI-4	SI-4(b)	CCI-002646	The organization identifies unauthorized use of the information system through organization-defined techniques and methods.	The organization being inspected/assessed identifies unauthorized use of the information system through techniques and methods defined in SI-4, CCI 2645. The organization must maintain an audit trail of identified instances of unauthorized use.	The organization conducting the inspection/assessment obtains and examines the audit trail of identified instances of unauthorized use to ensure the organization being inspected/assessed identifies unauthorized use of the information system through techniques and methods defined in SI-4, CCI 2645.	TRUE		X		X					Enclave Non-Designer	---
2480	SI-4	SI-4(c)	CCI-001255	The organization deploys monitoring devices strategically within the information system to collect organization determined essential information.	The organization being inspected/assessed documents and implements a process to deploy monitoring devices strategically within the information system to collect organization determined essential information.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed deploys monitoring devices strategically within the information system to collect organization determined essential information.	TRUE				X					Non-Designer	---
2481	SI-4	SI-4(c)	CCI-001256	The organization deploys monitoring devices at ad hoc locations within the system to track specific types of transactions of interest to the organization.	The organization being inspected/assessed documents and implements a process to deploy monitoring devices at ad hoc locations within the system to track specific types of transactions of interest to the organization.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed deploys monitoring devices at ad hoc locations within the system to track specific types of transactions of interest to the organization.	TRUE		X		X					Enclave Non-Designer	---
2482	SI-4	SI-4(d)	CCI-002647	The organization protects information obtained from intrusion-monitoring tools from unauthorized access.	The organization being inspected/assessed documents and implements a process to protect information obtained from intrusion-monitoring tools from unauthorized access.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed protects information obtained from intrusion-monitoring tools from unauthorized access.	TRUE		X		X					Enclave Non-Designer	---
2483	SI-4	SI-4(d)	CCI-002648	The organization protects information obtained from intrusion-monitoring tools from unauthorized modification.	The organization being inspected/assessed documents and implements a process to protect information obtained from intrusion-monitoring tools from unauthorized modification.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed protects information obtained from intrusion-monitoring tools from unauthorized modification.	TRUE		X		X					Enclave Non-Designer	---
2484	SI-4	SI-4(d)	CCI-002649	The organization protects information obtained from intrusion-monitoring tools from unauthorized deletion.	The organization being inspected/assessed documents and implements a process to protect information obtained from intrusion-monitoring tools from unauthorized deletion.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed protects information obtained from intrusion-monitoring tools from unauthorized deletion.	TRUE		X		X					Enclave Non-Designer	---
2485	SI-4	SI-4(e)	CCI-001257	The organization heightens the level of information system monitoring activity whenever there is an indication of increased risk to organizational operations and assets, individuals, other organizations, or the Nation based on law enforcement information, intelligence information, or other credible sources of information.	The organization being inspected/assessed documents and implements a process to heighten the level of information system monitoring activity whenever there is an indication of increased risk to organizational operations and assets, individuals, other organizations, or the Nation based on law enforcement information, intelligence information, or other credible sources of information.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed heightens the level of information system monitoring activity whenever there is an indication of increased risk to organizational operations and assets, individuals, other organizations, or the Nation based on law enforcement information, intelligence information, or other credible sources of information.	TRUE		X		X					Enclave Non-Designer	---
2486	SI-4	SI-4(f)	CCI-001258	The organization obtains legal opinion with regard to information system monitoring activities in accordance with applicable federal laws, Executive Orders, directives, policies, or regulations.	The organization being inspected/assessed obtains and documents legal opinion with regard to information system monitoring activities in accordance with applicable federal laws, Executive Orders, directives, policies, or regulations.	The organization conducting the inspection/assessment obtains and examines the documented legal opinion to ensure the organization being inspected/assessed obtains legal opinion with regard to information system monitoring activities in accordance with applicable federal laws, Executive Orders, directives, policies, or regulations.	TRUE		X		X					Enclave Non-Designer	---
2487	SI-4	SI-4(g)	CCI-002650	The organization defines the information system monitoring information that is to be provided the organization-defined personnel or roles.	The organization being inspected/assessed defines and documents the information system monitoring information that is to be provided the organization-defined personnel or roles. DoD has determined the information system monitoring information is not appropriate to define at the Enterprise	The organization conducting the inspection/assessment obtains and examines the documented information system monitoring information to ensure the organization being inspected/assessed defines the information system monitoring information that is to be provided the organization-defined personnel or roles. DoD has determined the information system monitoring information is not	TRUE		X		X					Enclave Non-Designer	---
2488	SI-4	SI-4(g)	CCI-002651	The organization defines the personnel or roles that are to be provided organization-defined information system monitoring information.	The organization being inspected/assessed defines and documents the personnel or roles that are to be provided organization-defined information system monitoring information. DoD has determined the personnel or roles are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented personnel or roles to ensure the organization being inspected/assessed defines the personnel or roles that are to be provided organization-defined information system monitoring information. DoD has determined the personnel or roles are not appropriate to define at the Enterprise level.	TRUE		X		X					Enclave Non-Designer	---
2489	SI-4	SI-4(g)	CCI-002652	The organization defines the frequency at which the organization will provide the organization-defined information system monitoring information to organization-defined personnel or roles	The organization being inspected/assessed defines and documents the frequency at which the organization will provide the organization-defined information system monitoring information to organization-defined	The organization conducting the inspection/assessment obtains and examines the documented frequency to ensure the organization being inspected/assessed defines the frequency at which the organization will provide the organization-defined information system monitoring information to	TRUE		X		X					Enclave Non-Designer	---
2490	SI-4	SI-4(g)	CCI-002654	The organization provides organization-defined information system monitoring information to organization-defined personnel or roles as needed or per organization-defined frequency.	The organization being inspected/assessed provides information system monitoring information defined in SI-4, CCI 2650 to personnel or roles defined in SI-4, CCI 2651 as needed or per the frequency defined in SI-4, CCI 2652. The organization must maintain an audit trail of when	The organization conducting the inspection/assessment obtains and examines the audit trail of when information is provided to ensure the organization being inspected/assessed provides information system monitoring information defined in SI-4, CCI 2650 to personnel or roles defined in SI-4, CCI 2651 as needed or per the frequency defined in SI-4, CCI 2652.	TRUE		X		X					Enclave Non-Designer	---
2546	SI-5	SI-5(a)	CCI-002692	The organization defines the external organizations from which it receives information system security alerts, advisories and directives.	DoD has defined the external organizations as at a minimum, USCYBERCOM.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the external organizations as at a minimum,	TRUE	X	X							DoD-Defined Enclave	---

	PM-6	PM-6	CCI-000210	The organization monitors the results of information security measures of performance.	The Federal Information Systems Management Act (FISMA) meets the DoD requirements for information security performance measures of performance.	The Federal Information Systems Management Act (FISMA) meets the DoD requirements for information security performance measures of performance. DoD organizations are automatically compliant with this CCI as they are covered at the DoD level by FISMA.	TRUE	X									DoD-Defined	---
2689	PM-6	PM-6	CCI-000211	The organization reports on the results of information security measures of performance.	The organization being inspected/assessed reports the results of information security measures of performance IAW FISMA reporting guidance.	The organization conducting the inspection/assessment obtains and examines FISMA reporting documentation.	TRUE				X						Non-Designer	---
2690	PM-7	PM-7	CCI-000212	The organization develops an enterprise architecture with consideration for information security and the resulting risk to organizational operations, organizational assets, individuals, other organizations, and the Nation.	The GIG IA Architecture meets the DoD requirements for enterprise architecture. DoD components are automatically compliant with this CCI as they covered at the DoD level.	The GIG IA Architecture meets the DoD requirements for enterprise architecture. DoD components are automatically compliant with this CCI as they covered at the DoD level.	TRUE	X			X	X					DoD-Defined Non-Designer Impractical	---
2691	PM-8	PM-8	CCI-000216	The organization develops and documents a critical infrastructure and key resource protection plan that addresses information security issues.	DoDD 3020.40 meets the DoD requirement for the development of a critical infrastructure and key resource protection plan. DoD components are automatically compliant with this CCI as they are covered by the DoD level, DoDD 3020.40.	DoDD 3020.40 meets the DoD requirement for the development of a critical infrastructure and key resource protection plan. DoD components are automatically compliant with this CCI as they are covered by the DoD level, DoDD 3020.40.	TRUE						X		X	0	---	
2692	PM-8	PM-8	CCI-001640	The organization updates the critical infrastructure and key resources protection plan that addresses information security issues.	DoDD 3020.40 meets the DoD requirement for the development of a critical infrastructure and key resource protection plan. DoD components are automatically compliant with this CCI as they are covered by the DoD level, DoDD 3020.40.	DoDD 3020.40 meets the DoD requirement for the development of a critical infrastructure and key resource protection plan. DoD components are automatically compliant with this CCI as they are covered by the DoD level, DoDD 3020.40.	TRUE						X		X	0	---	
2693	PM-9	PM-9(a)	CCI-000227	The organization develops a comprehensive strategy to manage risk to organizational operations and assets, individuals, other organizations, and the Nation associated with the operation and use of information systems.	DoD Risk Management Framework meets the requirement for a comprehensive organizational risk strategy. DoD components are automatically compliant with this CCI because they are covered by the DoD Risk Management Framework (DoDI 8510.01).	DoD Risk Management Framework meets the requirement for a comprehensive organizational risk strategy. DoD components are automatically compliant with this CCI because they are covered by DoD Risk Management Framework (DoDI 8510.01).	TRUE	X									DoD-Defined	---
2694	PM-9	PM-9(b)	CCI-000228	The organization implements a comprehensive strategy to manage risk to organization operations and assets, individuals, other organizations, and the Nation associated with the operation and use of information systems consistently across the organization.	DoD Risk Management Framework meets the requirement for a comprehensive organizational risk strategy. DoD components are automatically compliant with this CCI because they are covered by the DoD Risk Management Framework (DoDI 8510.01).	DoD Risk Management Framework meets the requirement for a comprehensive organizational risk strategy. DoD components are automatically compliant with this CCI because they are covered by DoD Risk Management Framework (DoDI 8510.01).	TRUE	X									DoD-Defined	---
2695	PM-9	PM-9(c)	CCI-002994	The organization reviews and updates the risk management strategy in accordance with organization-defined frequency or as required, to address organizational changes.	DoD Risk Management Framework meets the requirement for a comprehensive organizational risk strategy. DoD components are automatically compliant with this CCI because they are covered by the DoD Risk Management Framework (DoDI 8510.01).	DoD Risk Management Framework meets the requirement for a comprehensive organizational risk strategy. DoD components are automatically compliant with this CCI because they are covered by DoD Risk Management Framework (DoDI 8510.01).	TRUE	X									DoD-Defined	---
2696	PM-9	PM-9(c)	CCI-002995	The organization defines the frequency to review and update the risk management strategy to address organizational changes.	DoD has defined the frequency as reviewed annually - updated as appropriate but at least within 10 years of date of issuance.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the frequency as reviewed annually - updated as appropriate but at least within 10 years of date of issuance.	TRUE	X									DoD-Defined	---
2697	PM-10	PM-10(a)	CCI-000229	The organization documents the security state of organizational information systems and the environments in which those systems operate through security authorization processes.	DoDI 8510.01 meets the DoD requirement to manage the security authorization process. DoD components are automatically compliant with this CCI because they are covered at the DoD level, DoDI 8510.01.	DoDI 8510.01 meets the DoD requirement to manage the security authorization process. DoD components are automatically compliant with this CCI because they are covered at the DoD level, DoDI 8510.01.	TRUE	X									DoD-Defined	---
2698	PM-10	PM-10(a)	CCI-000230	The organization tracks the security state of organizational information systems and the environments in which those systems operate through security authorization processes.	DoDI 8510.01 meets the DoD requirement to manage the security authorization process. DoD components are automatically compliant with this CCI because they are covered at the DoD level, DoDI 8510.01.	DoDI 8510.01 meets the DoD requirement to manage the security authorization process. DoD components are automatically compliant with this CCI because they are covered at the DoD level, DoDI 8510.01.	TRUE	X									DoD-Defined	---
2699	PM-10	PM-10(a)	CCI-000231	The organization reports the security state of organizational information systems and the environments in which those systems operate through security authorization processes.	DoDI 8510.01 meets the DoD requirement to manage the security authorization process.	DoDI 8510.01 meets the DoD requirement to manage the security authorization process.	TRUE	X									DoD-Defined	---
2700	PM-10	PM-10(b)	CCI-000233	The organization designates individuals to fulfill specific roles and responsibilities within the organizational risk management process.	DoDI 8510.01 meets the DoD requirement to designate roles and responsibilities for the risk management process.	DoDI 8510.01 meets the DoD requirement to designate roles and responsibilities for the risk management process. DoD components are automatically compliant with this CCI because they are covered at the DoD level, DoDI 8510.01.	TRUE	X									DoD-Defined	---
2701	PM-10	PM-10(c)	CCI-000234	The organization fully integrates the security authorization processes into an organization-wide risk management program.	DoDI 8510.01 meets the DoD requirement to fully integrate the security authorization process. DoD components are automatically compliant with this CCI because they are covered at the DoD level, DoDI 8510.01.	DoDI 8510.01 meets the DoD requirement to fully integrate the security authorization process. DoD components are automatically compliant with this CCI because they are covered at the DoD level, DoDI 8510.01.	TRUE	X									DoD-Defined	---
2702	PM-11	PM-11(a)	CCI-000235	The organization defines mission/business processes with consideration for information security and the resulting risk to organizational operations, organizational assets, individuals, other organizations, and the Nation.	DoDI 8510.01 meets the DoD requirement to define mission/business processes. DoD components are automatically compliant with this CCI as they are covered at the DoD level, DoDI 8510.01.	DoDI 8510.01 meets the DoD requirement to define mission/business processes. DoD components are automatically compliant with this CCI as they are covered at the DoD level, DoDI 8510.01.	TRUE	X									DoD-Defined	---
2704	PM-12	PM-12	CCI-002996	The organization implements an insider threat program that includes a cross-discipline insider threat incident handling team.	The organization being inspected/assessed documents and implements an insider threat program that includes a cross-discipline insider threat incident handling team.	The organization conducting the inspection/assessment obtains and examines the documented insider threat program to ensure the organization being inspected/assessed implements an insider threat program that includes a cross-discipline insider threat incident handling team.	TRUE				X						Non-Designer	---
2705	PM-13	PM-13	CCI-002997	The organization establishes an information security workforce development and improvement program.	DoD 8570.01-M, "Information Assurance Workforce Improvement Program" meets the DoD requirement to establish an information security workforce development and improvement program.	DoD 8570.01-M meets the DoD requirement to establish an information security workforce development and improvement program. DoD components are automatically compliant with this CCI as they are covered at the DoD level, DoDI 8510.01.	TRUE	X									DoD-Defined	---
2706	PM-14	PM-14(a)(1)	CCI-002998	The organization implements a process for ensuring that organizational plans for conducting security testing activities associated with organizational information systems are developed.	The organization being inspected/assessed documents and implements a process for ensuring that organizational plans for conducting security testing activities associated with organizational information systems are developed.	The organization conducting the inspection/assessment obtains and examines the documented process to ensure the organization being inspected/assessed implements a process for ensuring that organizational plans for conducting security testing activities associated with organizational information systems are developed.	TRUE				X						Non-Designer	---

1030	CP-12	CP-12	CCI-002857	The organization defines the restrictions of safe mode of operation that the information system will enter when organization-defined conditions are detected.	The organization being inspected/assessed defines and documents the restrictions of safe mode of operation that the information system will enter when organization-defined conditions are detected. DoD has determined the restrictions on safe mode of operation are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented restrictions to ensure the organization being inspected/assessed defines the restrictions of safe mode of operation that the information system will enter when organization-defined conditions are detected. DoD has determined the restrictions on safe mode of operation are not appropriate to define at the Enterprise level.	TRUE			X						Designer	3.8 SAFE MODE AND FAIL SAFE OPERATION
2130	SC-5	SC-5	CCI-001093	The organization defines the types of denial of service attacks (or provides references to sources of current denial of service attacks) that can be addressed by the information system .	The organization being inspected/assessed defines and documents the types of denial of service attacks (or provides references to sources of current denial of service attacks) that can be addressed by the information system.	The organization conducting the inspection/assessment obtains and examines the documented types of denial of service attacks to ensure the organization being inspected/assessed defines the types of denial of service attacks (or provides references to sources of current denial of service attacks) that can be addressed by the information system.	TRUE		X	X						Enclave Designer	3.7.2 Denial of Service Protection<TAI OP...
2131	SC-5	SC-5	CCI-002386	The organization defines the security safeguards to be employed to protect the information system against, or limit the effects of, denial of service attacks.	The organization being inspected/assessed defines and documents the security safeguards to be employed to protect the information system against, or limit the effects of, denial of service attacks. DoD has determined the security safeguards are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented security safeguards to ensure the organization being inspected/assessed defines the security safeguards to be employed to protect the information system against, or limit the effects of, denial of service attacks. DoD has determined the security safeguards are not appropriate to define at the Enterprise level.	TRUE		X	X	X					Enclave Designer Non-Designer	3.7.2 Denial of Service Protection<TAI OP...
2132	SC-5	SC-5	CCI-002385	The information system protects against or limits the effects of organization-defined types of denial of service attacks by employing organization-defined security safeguards.	The organization being inspected/assessed configures the information system to protect against or limits the effects of types of denial of service attacks defined in SC-5, CCI 1093 by employing security safeguards	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to protect against or limits the effects of types of denial of service attacks defined in SC-5, CCI 1093 by employing	TRUE		X	X						Enclave Designer	3.7.2 Denial of Service Protection<TAI OP...
779	CM-6	CM-6(a)	CCI-000363	The organization defines security configuration checklists to be used to establish and document configuration settings for the information system technology products employed.	DoD has defined the security configuration checklists as DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.).	DoD has defined the security configuration checklists as DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.).	TRUE			X						Designer	3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
780	CM-6	CM-6(a)	CCI-000364	The organization establishes configuration settings for information technology products employed within the information system using organization-defined security configuration checklists.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for establishing configuration settings.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for establishing configuration settings.	TRUE			X						Designer	3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
781	CM-6	CM-6(a)	CCI-000365	The organization documents configuration settings for information technology products employed within the information system using organization-defined security configuration checklists that reflect the most restrictive mode consistent with operational requirements.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for documenting configuration settings.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for documenting configuration settings. DoD Components are automatically compliant with this CCI because they are	TRUE	X		X	X	X				DoD-Defined Designer Non-Designer Impractical	3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
783	CM-6	CM-6(c)	CCI-001755	The organization defines the information system components for which any deviation from the established configuration settings are to be identified, documented and approved.	DoD has defined the information system components as all configurable information system components.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the information system components as all configurable information system components.	TRUE	X		X	X	X				DoD-Defined Designer Non-Designer Impractical	3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
465	AU-5	AU-5(a)	CCI-000139	The information system alerts designated organization-defined personnel or roles in the event of an audit processing failure.	The organization being inspected/assessed configures the information system to alert at a minimum, the SCA and ISSO in the event of an audit processing failure. For information system components that have	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed has configured the information system to alert at a minimum, the SCA and ISSO in the event of an audit processing failure.	TRUE		X	X		X				Enclave Designer Impractical	3.5.5 Response to Audit Processing Failur...
467	AU-5	AU-5(b)	CCI-000140	The information system takes organization defined actions upon audit failure (e.g., shut down information system, overwrite oldest audit records, stop generating audit records).	The organization being inspected/assessed configures the information system to take actions as defined in AU-5, CCI 1490 upon audit failure. For information system components that have applicable STIGs or SRGs, the organization being	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed has configured the information system to take actions as defined in AU-5, CCI 1490 upon audit failure. For information system components that have applicable STIGs or SRGs, the	TRUE		X	X		X				Enclave Designer Impractical	3.5.5 Response to Audit Processing Failur...
468	AU-5	AU-5(b)	CCI-001490	The organization defines actions to be taken by the information system upon audit failure (e.g., shut down information system, overwrite oldest audit records, stop generating audit records).	The organization being inspected/assessed will define and document actions to be taken by the information system upon audit failure. The organization shall consider trade-offs between the needs for system availability and audit integrity when defining the actions. Unless availability is an overriding concern, the default action should be to shut down the information system.	The organization conducting the inspection/assessment obtains and examines the documented actions to ensure the organization being inspected/assessed has defined the actions to be taken by the information system upon audit failure. DoD has determined that the actions are not appropriate to define at the Enterprise level.	TRUE		X	X	X	X				Enclave Designer Non-Designer Impractical	3.5.5 Response to Audit Processing Failur...
461	AU-4	AU-4	CCI-001848	The organization defines the audit record storage requirements.	The organization being inspected/assessed defines and documents the required audit record storage capacity. DoD has determined the audit record storage requirements are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented audit record storage requirements to ensure the organization being inspected/assessed has defined those requirements. DoD has determined the audit record storage requirements are not appropriate to define at the Enterprise level.	TRUE			X	X					Designer Non-Designer	3.5.4 Audit Storage Capacity and Audit Up...
462	AU-4	AU-4	CCI-001849	The organization allocates audit record storage capacity in accordance with organization-defined audit record storage requirements.	The organization being inspected/assessed allocates, and configures the information system to allocate audit record storage capacity as defined in AU-4, CCI 1848. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 1849.	The organization conducting the inspection/assessment examines the information system to ensure that the organization being inspected/assessed has configured the information system to allocate audit record storage capacity as defined in AU-4, CCI 1848. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs	TRUE			X	X					Designer Non-Designer	3.5.4 Audit Storage Capacity and Audit Up...
516	AU-8	AU-8(a)	CCI-000159	The information system uses internal system clocks to generate time stamps for audit records.	The organization being inspected/assessed configures the information system to use internal system clocks to generate time stamps for audit records. For information system components that have	The organization conducting the inspection/assessment examines the information system to ensure that the organization being inspected/assessed has configured the information system to use internal system clocks to generate time stamps for audit records.	TRUE			X						Designer	3.5.2 Audit Time Stamps
517	AU-8	AU-8(b)	CCI-001889	The information system records time stamps for audit records that meets organization-defined granularity of time measurement.	The organization being inspected/assessed configures the information system to generate time in the time stamps for audit records that meets one second granularity of time measurement. DoD has defined the granularity of time measurement	The organization conducting the inspection/assessment examines the information system to ensure that the organization being inspected/assessed has configured the information system to generate time in the time stamps for audit records that meets one second granularity of time measurement. DoD has defined the granularity of time measurement as one second.	TRUE			X						Designer	3.5.2 Audit Time Stamps
518	AU-8	AU-8(b)	CCI-001890	The information system records time stamps for audit records that can be mapped to Coordinated Universal Time (UTC) or Greenwich Mean Time (GMT).	The organization being inspected/assessed configures the information system to generate time stamps for audit records that contain time zones or time offsets that can be mapped to Coordinated Universal Time (UTC) or Greenwich Mean Time (GMT).	The organization conducting the inspection/assessment examines the information system to ensure that the organization being inspected/assessed has configured the information system to generate time stamps for audit records that contain time zones or time offsets that can be mapped to Coordinated Universal Time (UTC) or Greenwich Mean Time (GMT).	TRUE			X						Designer	3.5.2 Audit Time Stamps
440	AU-2	AU-2(a)	CCI-000123	The organization determines the information system must be capable of auditing an organization-defined list of auditable events.	The organization being inspected/assessed determines whether the information system is capable of auditing: - successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. Classification levels).	The organization conducting the inspection/assessment obtains and examines the documentation of the auditable events to ensure the information system is capable of auditing the: - successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. Classification levels).	TRUE			X	X					Designer Non-Designer	3.5.1 Audit Events, Content of Audit Reco...
441	AU-2	AU-2(a)	CCI-001571	The organization defines the information system auditable events.	DoD has defined the information system auditable events as successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels). Successful and unsuccessful	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the information system auditable events as successful and unsuccessful attempts to access, modify, or delete privileges, security objects,	TRUE	X		X		X				DoD-Defined Designer Impractical	3.5.1 Audit Events, Content of Audit Reco...
443	AU-2	AU-2(c)	CCI-000125	The organization provides a rationale for why the list of auditable events is deemed to be adequate to support after-the-fact investigations of security incidents.	The organization being inspected/assessed documents in the audit and accountability policy the list of auditable system events, the organization provides clearly stated rationale for the selection of each system event. The rationale will support any after-action investigations of security event.	The organization conducting the inspection/assessment obtains and examines the audit and accountability policy and procedures to ensure the organization being inspected/assess has defined the auditable system events, rationale for the selection, and that the organization has defined how the auditable events will support after-action investigations of security events.	TRUE			X	X					Designer Non-Designer	3.5.1 Audit Events, Content of Audit Reco...

444	AU-2	AU-2(d)	CCI-001485	The organization defines the events which are to be audited on the information system on an organization-defined frequency of (or situation requiring) auditing for each identified event.	The organization being inspected/assessed defines and documents events which are to be audited on the information system. Events should be selected from the events the information system is capable of auditing as defined in AU-2 (a) and should be based on ongoing risk assessments of current threat information and environment.	The organization conducting the inspection/assessment obtains and examines the documented list of events which are to be audited on the information system to ensure those events have been defined. DoD has determined that the events are not appropriate to define at the Enterprise level.	TRUE			X	X					Designer Non-Designer	3.5.1 Audit Events, Content of Audit Reco...
450	AU-3	AU-3	CCI-000130	The information system generates audit records containing information that establishes what type of event occurred.	The organization being inspected/assessed configures the information system to generate audit records containing information that establishes what type of event occurred	The organization conducting the inspection/assessment examines the information system to ensure that the organization being inspected/assessed has configured the information system to generate audit records containing information that establishes what type of event occurred. The organization	TRUE			X						Designer	3.5.1 Audit Events, Content of Audit Reco...
451	AU-3	AU-3	CCI-000131	The information system generates audit records containing information that establishes when an event occurred.	The organization being inspected/assessed configures the information system to generate audit records containing information that establishes when an event occurred	The organization conducting the inspection/assessment examines the information system to ensure that the organization being inspected/assessed has configured the information system to generate audit records containing information that establishes when an event occurred. The organization conducting the inspection/assessment reviews the audit records generated to	TRUE			X						Designer	3.5.1 Audit Events, Content of Audit Reco...
452	AU-3	AU-3	CCI-000132	The information system generates audit records containing information that establishes where the event occurred.	The organization being inspected/assessed configures the information system to generate audit records containing information that establishes where the event occurred For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG	The organization conducting the inspection/assessment examines the information system to ensure that the organization being inspected/assessed has configured the information system to generate audit records containing information that establishes where the event occurred. The organization conducting the inspection/assessment reviews the audit records generated to ensure that the records contain information that establishes where the event occurred.	TRUE			X						Designer	3.5.1 Audit Events, Content of Audit Reco...
453	AU-3	AU-3	CCI-000133	The information system generates audit records containing information that establishes the source of the event.	The organization being inspected/assessed configures the information system to generate audit records containing information that establishes the source of the event. For information system components that have applicable STIGs or SRGs, the organization being	The organization conducting the inspection/assessment examines the information system to ensure that the organization being inspected/assessed has configured the information system to generate audit records containing information that establishes the source of the event. The organization conducting the inspection/assessment reviews the audit records generated to ensure that the records contain information that establishes the source of the event.	TRUE			X						Designer	3.5.1 Audit Events, Content of Audit Reco...
454	AU-3	AU-3	CCI-000134	The information system generates audit records containing information that establishes the outcome of the event.	The organization being inspected/assessed configures the information system to generate audit records containing information that establishes the outcome of the event. For information system components that have	The organization conducting the inspection/assessment examines the information system to ensure that the organization being inspected/assessed has configured the information system to generate audit records containing information that establishes the outcome of the event. The organization conducting the inspection/assessment reviews the audit records generated to ensure that the records contain information that establishes the outcome of	TRUE			X						Designer	3.5.1 Audit Events, Content of Audit Reco...
455	AU-3	AU-3	CCI-001487	The information system generates audit records containing information that establishes the identity of any individuals or subjects associated with the event.	The organization being inspected/assessed configures the information system to generate audit records containing information that establishes the identity of any individuals or subjects associated with the event.	The organization conducting the inspection/assessment examines the information system to ensure that the organization being inspected/assessed has configured the information system to generate audit records containing information that establishes the identity of any individuals or subjects	TRUE			X		X				Designer Impractical	3.5.1 Audit Events, Content of Audit Reco...
562	AU-12	AU-12(a)	CCI-000169	The information system provides audit record generation capability for the auditable events defined in AU-2 a at organization defined information system components.	The organization being inspected/assessed acquires or designs all information system and network components that provide audit record generation capability for the auditable events defined in AU-2 a. DoD has defined the information system components as all information system and network components.	The organization conducting the inspection/assessment examines the information system to ensure that all information system and network components provide audit record generation capability for the auditable events defined in AU-2 a. DoD has defined the information system components as all information system and network components.	TRUE			X						Designer	3.5.1 Audit Events, Content of Audit Reco...
563	AU-12	AU-12(a)	CCI-001459	The organization defines information system components that provide audit record generation capability.	DoD has defined the information system components as all information system and network components.	DoD has defined the information system components as all information system and network components.	TRUE	X		X		X				DoD-Defined Designer Impractical	3.5.1 Audit Events, Content of Audit Reco...
564	AU-12	AU-12(b)	CCI-000171	The information system allows organization-defined personnel or roles to select which auditable events are to be audited by specific components of the information system.	The organization being inspected/assessed configures the information system to ensure that only the ISSM or individuals appointed by the ISSM select which auditable events are to be audited by specific components of the information system. DoD has defined the personnel or roles as the ISSM or	The organization conducting the inspection/assessment examines a sampling of information system components and confirms that the individuals capable of selecting auditable events are the ISSM or individuals appointed by the ISSM. DoD has defined the personnel or roles as the ISSM or individuals appointed by the ISSM.	TRUE			X		X				Designer Impractical	3.5.1 Audit Events, Content of Audit Reco...
565	AU-12	AU-12(b)	CCI-001910	The organization defines the personnel or roles allowed select which auditable events are to be audited by specific components of the information system.	DoD has defined the personnel or roles as the ISSM or individuals appointed by the ISSM.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the personnel or roles as the ISSM or individuals appointed by the ISSM.	TRUE	X		X		X				DoD-Defined Designer Impractical	3.5.1 Audit Events, Content of Audit Reco...
566	AU-12	AU-12(c)	CCI-000172	The information system generates audit records for the events defined in AU-2 d with the content defined in AU-3.	The organization being inspected/assessed configures the information system to generate audit records for the events defined in AU-2 d with the content defined in AU-3. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG	The organization conducting the inspection/assessment examines the information system to ensure that the system generates audit records for the events defined in AU-2 d with the content defined in AU-3. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs	TRUE			X						Designer	3.5.1 Audit Events, Content of Audit Reco...
1174	IA-6	IA-6	CCI-000206	The information system obscures feedback of authentication information during the authentication process to protect the information from possible exploitation/use by unauthorized individuals.	The organization being inspected/assessed configures the information system to obscure feedback of authentication information during the authentication process to protect the information from possible exploitation/use by unauthorized individuals. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to obscure feedback of authentication information during the authentication process to protect the information from possible exploitation/use by unauthorized individuals. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the	TRUE		X	X		X				Enclave Designer Impractical	3.4.6 Authenticator Feedback
1046	IA-2(1)	IA-2(1)	CCI-000765	The information system implements multifactor authentication for network access to privileged accounts.	The organization being inspected/assessed configures the information system to implement multifactor authentication for network access to privileged accounts. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 765.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to implement multifactor authentication for network access to privileged accounts. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 765.	TRUE		X	X		X				Enclave Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1069	IA-2(12)	IA-2(12)	CCI-001953	The information system accepts Personal Identity Verification (PIV) credentials.	The organization being inspected/assessed configures the information system to accept PIV/CAC authentication. This control enhancement applies to organizations	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to accept PIV/CAC authentication. For information system components that have applicable STIGs or SRGs, the	TRUE		X	X		X				Enclave Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1070	IA-2(12)	IA-2(12)	CCI-001954	The information system electronically verifies Personal Identity Verification (PIV) credentials.	The organization being inspected/assessed configures the information system to verify PIV/CAC authentication.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to verify PIV/CAC authentication.	TRUE		X	X		X				Enclave Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...

	IA-5	IA-5(c)	CCI-001544	The organization manages information system authenticators by ensuring that authenticators have sufficient strength of mechanism for their intended use.	The organization being inspected/assessed documents and implements authenticator strength mechanisms sufficient for the intended use of the authenticators.	The organization conducting the inspection/assessment obtains and examines documented authenticator strength mechanisms to ensure that they are defined and that the mechanisms have sufficient strength for the intended use of the authenticators.	TRUE			X	X	X				Designer Non-Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1116	IA-5	IA-5(e)	CCI-001989	The organization manages information system authenticators by changing default content of authenticators prior to information system installation.	The organization being inspected/assessed documents and implements a procedures to change default authenticators prior to information system installation.	The organization conducting the inspection/assessment obtains and examines the documented procedures to change default authenticators to ensure the procedures are defined. The organization conducting the inspection/assessment obtains and examines a sampling of authenticator age data for default accounts to ensure that default authenticators are changed prior to installation.	TRUE			X						Designer	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1120	IA-5	IA-5(g)	CCI-000182	The organization manages information system authenticators by changing/refreshing authenticators in accordance with the organization defined time period by authenticator type.	The organization being inspected/assessed documents and implements procedures for changing/refreshing authenticators in the following time periods: CAC - every 3 years, or 1 year from term of contract Password: 60 days Biometrics: every 3 years. DoD has defined the time period as CAC - every 3 years, or 1 year from term of contract Password: 60 days Biometrics: every 3 years.	The organization conducting the inspection/assessment obtains and examines the documented procedures for authenticator change/refresh to ensure the procedures are defined. The organization conducting the inspection/assessment obtains and examines a sampling of authenticator age data to ensure that authenticators are changed or refreshed in the following time periods: CAC - every 3 years, or 1 year from term of contract Password: 60 days Biometrics: every 3 years. DoD has defined the time period as CAC - every 3 years, or 1 year from term of contract	TRUE	X		X	X	X				DoD-Defined Designer Non-Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1121	IA-5	IA-5(g)	CCI-001610	The organization defines the time period (by authenticator type) for changing/refreshing authenticators.	DoD has defined the time period as CAC - every 3 years, or 1 year from term of contract Password: 60 days Biometrics: every 3 years.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as CAC - every 3 years, or 1 year from term of contract	TRUE	X		X	X	X				DoD-Defined Designer Non-Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1127	IA-5(1)	IA-5(1)(a)	CCI-000192	The information system enforces password complexity by the minimum number of upper case characters used.	The organization being inspected/assessed configures the information system to enforce password complexity by the minimum number of upper case characters used.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enforce password complexity by the minimum number of upper case characters used.	TRUE		X	X						Enclave Designer	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1128	IA-5(1)	IA-5(1)(a)	CCI-000193	The information system enforces password complexity by the minimum number of lower case characters used.	The organization being inspected/assessed configures the information system to enforce password complexity by the minimum number of lower case characters used. For information system components that have applicable STIGs or SRGs, the organization being	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enforce password complexity by the minimum number of lower case characters used. For information system components that have applicable STIGs or SRGs, the	TRUE		X	X						Enclave Designer	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1129	IA-5(1)	IA-5(1)(a)	CCI-000194	The information system enforces password complexity by the minimum number of numeric characters used.	The organization being inspected/assessed configures the information system to enforce password complexity by the minimum number of numeric characters used. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 194.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enforce password complexity by the minimum number of numeric characters used. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 194.	TRUE		X	X						Enclave Designer	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1130	IA-5(1)	IA-5(1)(a)	CCI-000205	The information system enforces minimum password length.	The organization being inspected/assessed configures the information system to enforce minimum password length. For information system components that have	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enforce minimum password length. For information system components that have applicable STIGs or SRGs, the	TRUE		X	X						Enclave Designer	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1131	IA-5(1)	IA-5(1)(a)	CCI-001619	The information system enforces password complexity by the minimum number of special characters used.	The organization being inspected/assessed configures the information system to enforce password complexity by the minimum number of special characters used.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enforce password complexity by the minimum number of special characters used.	TRUE		X	X						Enclave Designer	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1132	IA-5(1)	IA-5(1)(a)	CCI-001611	The organization defines the minimum number of special characters for password complexity enforcement.	DoD has defined the minimum number of special characters for password complexity enforcement as one special character.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the minimum number of special characters for password	TRUE	X		X		X				DoD-Defined Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1133	IA-5(1)	IA-5(1)(a)	CCI-001612	The organization defines the minimum number of upper case characters for password complexity enforcement.	DoD has defined the minimum number of upper case characters for password complexity enforcement as one upper-case character.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the minimum number of upper case characters for password	TRUE	X		X		X				DoD-Defined Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1134	IA-5(1)	IA-5(1)(a)	CCI-001613	The organization defines the minimum number of lower case characters for password complexity enforcement.	DoD has defined the minimum number of lower case characters for password complexity enforcement as one lower-case character.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the minimum number of lower case characters for password complexity enforcement as one lower-case character.	TRUE	X		X		X				DoD-Defined Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1135	IA-5(1)	IA-5(1)(a)	CCI-001614	The organization defines the minimum number of numeric characters for password complexity enforcement.	DoD has defined the minimum number of numeric characters for password complexity enforcement as one numeric character.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the minimum number of numeric characters for password complexity enforcement as one numeric character.	TRUE	X		X		X				DoD-Defined Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1136	IA-5(1)	IA-5(1)(b)	CCI-000195	The information system, for password-based authentication, when new passwords are created, enforces that at least an organization-defined number of characters are changed.	The organization being inspected/assessed configures the information system to enforce that at least 50% of the minimum password length is changed. For information system components that have	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enforce that at least 50% of the minimum password length is changed.	TRUE		X	X						Enclave Designer	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1137	IA-5(1)	IA-5(1)(b)	CCI-001615	The organization defines the minimum number of characters that are changed when new passwords are created.	DoD has defined the minimum number of characters as 50% of the minimum password length.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the minimum number of characters as 50% of the minimum password length.	TRUE	X		X		X				DoD-Defined Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...

1138	IA-5(1)	IA-5(1)(c)	CCI-000196	The information system, for password-based authentication, stores only cryptographically-protected passwords.	The organization being inspected/assessed configures the information system to store only encrypted representations of passwords. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 196.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to store only encrypted representations of passwords. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs	TRUE		X	X		X					Enclave Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1139	IA-5(1)	IA-5(1)(c)	CCI-000197	The information system, for password-based authentication, transmits only cryptographically-protected passwords.	The organization being inspected/assessed configures the information system to transmit only encrypted representations of passwords. For information system components that have	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to transmit only encrypted representations of passwords.	TRUE		X	X							Enclave Designer	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1140	IA-5(1)	IA-5(1)(d)	CCI-000198	The information system enforces minimum password lifetime restrictions.	The organization being inspected/assessed configures the information system to enforce minimum password lifetime restrictions.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enforce minimum password lifetime restrictions.	TRUE			X		X					Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1141	IA-5(1)	IA-5(1)(d)	CCI-000199	The information system enforces maximum password lifetime restrictions.	The organization being inspected/assessed configures the information system to enforce maximum password lifetime restrictions. For information system components that have	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enforce maximum password lifetime restrictions.	TRUE		X	X							Enclave Designer	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1142	IA-5(1)	IA-5(1)(d)	CCI-001616	The organization defines minimum password lifetime restrictions.	DoD has defined the minimum password lifetime restrictions as 24 hours.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the minimum password lifetime restrictions as 24 hours.	TRUE	X		X		X					DoD-Defined Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1143	IA-5(1)	IA-5(1)(d)	CCI-001617	The organization defines maximum password lifetime restrictions.	DoD has defined the maximum password lifetime restrictions as 60 days.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the maximum password lifetime restrictions as 60 days.	TRUE	X		X		X					DoD-Defined Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1144	IA-5(1)	IA-5(1)(e)	CCI-001618	The organization defines the number of generations for which password reuse is prohibited.	DoD has defined the number of generations as a minimum of 5.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the number of generations as a minimum of 5.	TRUE	X	X	X		X					DoD-Defined Enclave Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1145	IA-5(1)	IA-5(1)(e)	CCI-000200	The information system prohibits password reuse for the organization defined number of generations.	The organization being inspected/assessed configures the information system to prohibit reuse for a minimum of 5 generations. For information system components that have	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to prohibit reuse for a minimum of 5 generations.	TRUE		X	X	X	X					Enclave Designer Non-Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1146	IA-5(1)	IA-5(1)(f)	CCI-002041	The information system allows the use of a temporary password for system logons with an immediate change to a permanent password.	The organization being inspected/assessed configures the information system to allow the use of a temporary password for system logons with an immediate change to a permanent password.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to allow the use of a temporary password for system logons with an immediate change to a permanent password.	TRUE		X	X		X					Enclave Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1166	IA-5(11)	IA-5(11)	CCI-002002	The organization defines the token quality requirements to be employed by the information system mechanisms for token-based authentication.	DoDI 8520.03 defines types of authentication credentials that are acceptable for authentication to different systems based on the systems' information sensitivity levels and the users' access environments. The definitions for credential strengths D, E and H found in DoDI 8520.03 Enclosure 3, Section 3 specifically deal with acceptable types of hardware PKI credentials. DoD Components are automatically compliant with this CCI because they are covered by the DoD-level policy, DoDI 8520.03.	DoDI 8520.03 defines types of authentication credentials that are acceptable for authentication to different systems based on the systems' information sensitivity levels and the users' access environments. The definitions for credential strengths D, E and H found in DoDI 8520.03 Enclosure 3, Section 3 specifically deal with acceptable types of hardware PKI credentials. DoD Components are automatically compliant with this CCI because they are covered by the DoD-level policy, DoDI 8520.03.	TRUE	X	X	X		X					DoD-Defined Enclave Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
1167	IA-5(11)	IA-5(11)	CCI-002003	The information system, for token-based authentication, employs mechanisms that satisfy organization-defined token quality requirements.	The information system performing hardware token-based authentication must be configured to accept only DoD-approved PKI credentials in accordance with DoDI 8520.02 and DoDI 8520.03. For unclassified systems,	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed has configured the information system to accept only DoD-approved PKI credentials in accordance with (IAW) DoDI 8520.02 and DoDI 8520.03.	TRUE		X	X		X					Enclave Designer Impractical	3.4 USER IDENTIFICATION AND AUTHENTICAT...
2143	SC-7	SC-7(a)	CCI-001097	The information system monitors and controls communications at the external boundary of the system and at key internal boundaries within the system.	The organization being inspected/assessed documents and implements processes to monitor and control communications at the external boundary of the system and at key internal boundaries within the system.	The organization conducting the inspection/assessment obtains and examines the documented process as well as the audit trail of monitoring activities to ensure the organization being inspected/assessed monitors and controls communications at the external boundary of the system and at key internal boundaries within the system.	TRUE	X	X	X		X					DoD-Defined Enclave Designer Impractical	3.3.6 Physical Security in MODERATE Impact... 3.7.2 Denial of Service Protection<TAI OP... 3.7.5 Process Isolation and Boundary Prot...
244	AC-14	AC-14(a)	CCI-000061	The organization identifies and defines organization-defined user actions that can be performed on the information system without identification or authentication consistent with organizational missions/business functions.	The organization being inspected/assessed identifies, defines, and documents user actions that can be performed on the information system without identification or authentication consistent with organizational missions/business functions.	The organization conducting the inspection/assessment obtains and examines the documented user actions to ensure the organization being inspected/assessed identifies and defines the user actions that can be performed on the information system without identification and authentication.	TRUE			X							Designer	3.3.5 Permitted Actions Without Identific...
245	AC-14	AC-14(b)	CCI-000232	The organization documents and provides supporting rationale in the security plan for the information system, user actions not requiring identification and authentication.	The organization being inspected/assessed documents supporting rationale in the security plan for the actions defined in AC-14, CCI 61 to not require identification and authentication.	The organization conducting the inspection/assessment obtains and examines the security plan to ensure the organization being inspected/assessed documents the supporting rationale for the actions defined in AC-14, CCI 61 to not require identification and authentication.	TRUE			X							Designer	3.3.5 Permitted Actions Without Identific...
207	AC-8	AC-8(a)	CCI-002247	The organization defines the use notification message or banner the information system displays to users before granting access to the system.	DoD has defined the use notification message or banner as the content of DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the use notification message or banner as the content of DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013.	TRUE	X	X	X		X					DoD-Defined Enclave Designer Impractical	3.3.3 System Use Notification
208	AC-8	AC-8(a)	CCI-000048	The information system displays an organization-defined system use notification message or banner before granting access to the system that provides privacy and security notices consistent with applicable federal laws, Executive Orders, directives, policies, regulations, standards, and guidance.	The organization being inspected/assessed configures the information system to display the DoD Information Systems – Standard Consent Banner and User Agreement before granting access to the system that provides privacy and security notices consistent with applicable federal laws, Executive Orders, directives, policies, regulations, standards, and guidance.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to display the DoD Information Systems – Standard Consent Banner and User Agreement before granting access to the system that provides privacy and security notices consistent with applicable federal laws, Executive Orders, directives, policies, regulations, standards, and guidance.	TRUE		X	X		X					Enclave Designer Impractical	3.3.3 System Use Notification
209	AC-8	AC-8(a)(1)	CCI-002243	The organization-defined information system use notification message or banner is to state that users are accessing a U.S. Government information system.	DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013 meets the DoD requirements the information system use notification message or banner. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DTM 08-060.	DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013 meets the DoD requirements the information system use notification message or banner. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DTM 08-060.	TRUE	X	X	X		X					DoD-Defined Enclave Designer Impractical	3.3.3 System Use Notification

210	AC-8	AC-8(a)(2)	CCI-002244	The organization-defined information system use notification message or banner is to state that information system usage may be monitored, recorded, and subject to audit.	DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013 meets the DoD requirements the information system use notification message or banner. DoD Components are automatically compliant with this	DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013 meets the DoD requirements the information system use notification message or banner. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DTM 08-060.	TRUE	X	X	X		X				DoD-Defined Enclave Designer Impractical	3.3.3 System Use Notification
211	AC-8	AC-8(a)(3)	CCI-002245	The organization-defined information system use notification message or banner is to state that unauthorized use of the information system is prohibited and subject to criminal and civil penalties.	DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013 meets the DoD requirements the information system use notification message or banner.	DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013 meets the DoD requirements the information system use notification message or banner.	TRUE	X	X	X		X				DoD-Defined Enclave Designer Impractical	3.3.3 System Use Notification
212	AC-8	AC-8(a)(4)	CCI-002246	The organization-defined information system use notification message or banner is to state that use of the information system indicates consent to monitoring and recording.	DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013 meets the DoD requirements the information system use notification message or banner. DoD Components are automatically compliant with this	DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013 meets the DoD requirements the information system use notification message or banner. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DTM 08-060.	TRUE	X	X	X		X				DoD-Defined Enclave Designer Impractical	3.3.3 System Use Notification
213	AC-8	AC-8(b)	CCI-000050	The information system retains the notification message or banner on the screen until users acknowledge the usage conditions and take explicit actions to log on to or further access.	The organization being inspected/assessed configures the information system to retain the notification message or banner on the screen until users acknowledge the usage conditions and take explicit actions to log on to or further access.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to retain the notification message or banner on the screen until users acknowledge the usage conditions and take explicit actions to log on to or further access.	TRUE		X	X						Enclave Designer	3.3.3 System Use Notification
214	AC-8	AC-8(c)(1)	CCI-002248	The organization defines the conditions of use which are to be displayed to users of the information system before granting further access.	DoD has defined the conditions as the content of DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the conditions as the content of DTM 08-060, "Policy on Use of Department of Defense (DoD) Information Systems – Standard Consent Banner and User Agreement," March 2013.	TRUE	X	X	X		X				DoD-Defined Enclave Designer Impractical	3.3.3 System Use Notification
197	AC-7	AC-7(a)	CCI-000043	The organization defines the maximum number of consecutive invalid logon attempts to the information system by a user during an organization-defined time period.	DoD has defined the maximum number as three.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the maximum number as three.	TRUE	X		X		X				DoD-Defined Designer Impractical	3.3.2 Unsuccessful Logon Attempts
198	AC-7	AC-7(a)	CCI-000044	The information system enforces the organization-defined limit of consecutive invalid logon attempts by a user during the organization-defined time period.	The organization being inspected/assessed configures the information system to limit invalid logon attempts by a user to three attempts during a 15 minute time period. For information system components that have	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to limit invalid logon attempts by a user to three attempts during a 15 minute time period.	TRUE			X						Designer	3.3.2 Unsuccessful Logon Attempts
199	AC-7	AC-7(a)	CCI-001423	The organization defines the time period in which the organization-defined maximum number of consecutive invalid logon attempts occur.	DoD has defined the time period as 15 minutes.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as 15 minutes.	TRUE	X		X		X				DoD-Defined Designer Impractical	3.3.2 Unsuccessful Logon Attempts
200	AC-7	AC-7(b)	CCI-002236	The organization defines the time period the information system will automatically lock the account or node when the maximum number of unsuccessful attempts is exceeded.	DoD has defined the time period as until released by an administrator.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the time period as until released by an administrator.	TRUE	X		X		X				DoD-Defined Designer Impractical	3.3.2 Unsuccessful Logon Attempts
201	AC-7	AC-7(b)	CCI-002237	The organization defines the delay algorithm to be employed by the information system to delay the next login prompt when the maximum number of unsuccessful attempts is exceeded.	DoD has defined the delay algorithm as a minimum of 5 seconds.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the delay algorithm as a minimum of 5 seconds.	TRUE	X		X		X				DoD-Defined Designer Impractical	3.3.2 Unsuccessful Logon Attempts
202	AC-7	AC-7(b)	CCI-002238	The information system automatically locks the account or node for either an organization-defined time period, until the locked account or node is released by an administrator, or delays the next login prompt according to the	The organization being inspected/assessed configures the information system to automatically lock the account or node until the locked account is released by an administrator and delays the next login prompt for a	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to automatically lock the account or node until the locked account is released by an administrator and delays the next	TRUE			X		X				Designer Impractical	3.3.2 Unsuccessful Logon Attempts
1045	IA-2	IA-2	CCI-000764	The information system uniquely identifies and authenticates organizational users (or processes acting on behalf of organizational users).	The organization being inspected/assessed configures the information system to uniquely identify and authenticate organizational users (or processes acting on behalf of organizational users).	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to uniquely identify and authenticate organizational users (or processes acting on behalf of organizational users).	TRUE		X	X		X				Enclave Designer Impractical	3.3.1 User Accounts 3.4 USER IDENTIFICATION AND AUTHENTICAT...
11	AC-2	AC-2(a)	CCI-002110	The organization defines the information system account types that support the organizational missions/business functions.	The organization being inspected/assessed defines and documents the information system account types that support the organizational missions/business functions. DoD has determined the information system account types are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented information system account types to ensure the organization being inspected/assessed defines the information system account types that support the organizational missions/business functions. DoD has determined the information system account types are not appropriate to define at the Enterprise level.	TRUE			X						Designer	3.3.1 User Accounts
77	AC-3	AC-3	CCI-000213	The information system enforces approved authorizations for logical access to information and system resources in accordance with applicable access control policies.	The organization being inspected/assessed configures the information system to enforce approved authorizations for logical access to information and system resources in accordance with applicable access control policies. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 213.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to enforce approved authorizations for logical access to information and system resources in accordance with applicable access control policies. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs	TRUE			X						Designer	3.3.1 User Accounts
1175	IA-7	IA-7	CCI-000803	The information system implements mechanisms for authentication to a cryptographic module that meet the requirements of applicable federal laws, Executive Orders, directives, policies, regulations, standards, and guidance	The organization being inspected/assessed configures the information system to implement mechanisms for authentication to a cryptographic module that meet the requirements of applicable federal laws, Executive	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to implement mechanisms for authentication to a cryptographic module that meet the requirements of	TRUE		X	X		X				Enclave Designer Impractical	3.2.8 Cryptographic Module Authentication
2223	SC-13	SC-13	CCI-002449	The organization defines the cryptographic uses, and type of cryptography required for each use, to be implemented by the information system.	DoD has defined the cryptographic uses and type of cryptography required for each use as protection of classified information: NSA-approved cryptography; provision of digital signatures and hashing: FIPS-validated cryptography.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the cryptographic uses and type of cryptography required for each use as protection of classified information: NSA-approved cryptography;	TRUE	X	X	X		X	X		X	DoD-Defined Enclave Designer Impractical	3.2.6 Cryptographic Protection
2224	SC-13	SC-13	CCI-002450	The information system implements organization-defined cryptographic uses and type of cryptography required for each use in accordance with applicable federal laws, Executive Orders, directives, policies, regulations, and standards.	The organization being inspected/assessed configures the information system to implement, for, protection of classified information: NSA-approved cryptography; for provision of digital signatures and hashing: FIPS-validated cryptography in accordance with applicable	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to implement, for, protection of classified information: NSA-approved cryptography; for provision of digital signatures and hashing: FIPS-validated cryptography in accordance with applicable	TRUE		X	X		X	X		X	Enclave Designer Impractical	3.2.6 Cryptographic Protection
798	CM-7	CM-7(b)	CCI-000382	The organization configures the information system to prohibit or restrict the use of organization-defined functions, ports, protocols, and/or services.	The organization being inspected/assessed configures the information system to prohibit or restrict the use of functions, ports, protocols, and/or services IAW DoDI 8551.01. DoD has defined the information system prohibited or restricted functions, ports, protocols, and/or services as IAW DoDI 8551.01.	The organization conducting the inspection/assessment inspects the information system to ensure the organization being inspected/assessed prohibits or restricts the use of functions, ports, protocols, and/or services IAW DoDI 8551.01. DoD has defined the information system prohibited or restricted functions, ports, protocols, and/or services as IAW DoDI 8551.01.	TRUE			X						Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
799	CM-7	CM-7(b)	CCI-000380	The organization defines for the information system prohibited or restricted functions, ports, protocols, and/or services.	DoD has defined the information system prohibited or restricted functions, ports, protocols, and/or services as IAW DoDI 8551.01.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the information system prohibited or restricted functions, ports, protocols, and/or services as IAW DoDI 8551.01.	TRUE			X						Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...

800	CM-7	CM-7(a)	CCI-000381	The organization configures the information system to provide only essential capabilities.	The organization being inspected/assessed documents in the security plan, essential capabilities which the information system must provide. The organization being inspected/assessed configures the information	The organization conducting the inspection/assessment obtains and examines the security plan to ensure the organization being inspected/assessed has identified essential capabilities. The organization conducting the inspection/assessment inspects the information system to ensure that it	TRUE			X						Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
803	CM-7(1)	CM-7(1)(b)	CCI-001761	The organization defines the functions, ports, protocols and services within the information system that are to be disabled when deemed unnecessary and/or nonsecure.	The organization being inspected/assessed must define and document in the system security plan, the functions, ports, protocols and services within the information system that are to be disabled when	The organization conducting the inspection/assessment obtains and examines the system security plan to ensure the organization being inspected/assessed defines the functions, ports, protocols and services within the information system that are to be disabled when deemed unnecessary.	TRUE			X						Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
804	CM-7(1)	CM-7(1)(b)	CCI-001762	The organization disables organization-defined functions, ports, protocols, and services within the information system deemed to be unnecessary and/or nonsecure.	The organization being inspected/assessed must disable functions, ports, protocols, and services within the information system deemed to be unnecessary and/or nonsecure as defined in CM-7 (1), CCI 1761.	The organization conducting the inspection/assessment inspects the information system to ensure the organization being inspected/assessed disables functions, ports, protocols, and services within the information system deemed to be unnecessary and/or nonsecure as defined in CM-7 (1), CCI 1761.	TRUE			X		X				Designer Impractical	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
790	CM-6	CM-6(a)	CCI-001588	The organization-defined security configuration checklists reflect the most restrictive mode consistent with operational requirements.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for ensuring security configuration checklists reflect the most restrictive mode consistent with operational requirements.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for ensuring security configuration checklists reflect the most restrictive mode consistent with operational requirements.	TRUE	X		X	X	X				DoD-Defined Designer Non-Designer Impractical	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
2381	SC-41	SC-41	CCI-002544	The organization defines the information systems or information system components on which organization-defined connection ports or input/output devices are to be physically disabled or removed.	The organization being inspected/assessed defines and documents the information systems or information system components on which organization-defined connection ports or input/output devices are to be physically disabled or removed.	The organization conducting the inspection/assessment obtains and examines the documented information systems or information system components to ensure the organization being inspected/assessed defines the information systems or information system components on which organization-defined connection ports or input/output devices are to be physically disabled or removed.	TRUE		X	X	X					Enclave Designer Non-Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
2382	SC-41	SC-41	CCI-002545	The organization defines the connection ports or input/output devices that are to be physically disabled or removed from organization-defined information systems or information system components.	The organization being inspected/assessed defines and documents the connection ports or input/output devices that are to be physically disabled or removed from organization-defined information systems or information system components.	The organization conducting the inspection/assessment obtains and examines the documented connection ports or input/output devices to ensure the organization being inspected/assessed defines the connection ports or input/output devices that are to be physically disabled or removed from organization-defined information systems or information system components.	TRUE		X	X	X					Enclave Designer Non-Designer	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
2383	SC-41	SC-41	CCI-002546	The organization physically disables or removes organization-defined connection ports or input/output devices on organization-defined information systems or information system components.	The organization being inspected/assessed physically disables or removes connection ports or input/output devices defined in SC-41, CCI 2545 on information systems or information system components defined in SC-41, CCI 2544.	The organization conducting the inspection/assessment examines a sampling of devices to ensure the organization being inspected/assessed physically disables or removes connection ports or input/output devices defined in SC-41, CCI 2545 on information systems or information system components defined in SC-41, CCI 2544.	TRUE			X		X				Designer Impractical	3.2.5 IP Control Networks 3.6 REQUIREMENTS FOR LEAST FUNCTIONALIT...
328	AC-18	AC-18(a)	CCI-001438	The organization establishes usage restrictions for wireless access.	The organization being inspected/assessed establishes and documents usage restrictions for wireless access.	The organization conducting the inspection/assessment obtains and examines documented usage restrictions to ensure the organization being inspected/assessed establishes usage restrictions for wireless access.	TRUE			X	X					Designer Non-Designer	3.2.3 Wireless and Wired Broadcast Commun...
329	AC-18	AC-18(a)	CCI-002323	The organization establishes configuration/connection requirements for wireless access.	The organization being inspected/assessed establishes and documents configuration/connection requirements for wireless access.	The organization conducting the inspection/assessment obtains and examines the documented configuration/connection requirements to ensure the organization being inspected/assessed establishes configuration/connection requirements for wireless access.	TRUE			X	X					Designer Non-Designer	3.2.3 Wireless and Wired Broadcast Commun...
330	AC-18	AC-18(a)	CCI-001439	The organization establishes implementation guidance for wireless access.	The organization being inspected/assessed establishes and documents implementation guidance for wireless access.	The organization conducting the inspection/assessment obtains and examines the documented implementation guidance to ensure the organization being inspected/assessed establishes implementation guidance for wireless access.	TRUE			X	X					Designer Non-Designer	3.2.3 Wireless and Wired Broadcast Commun...
331	AC-18	AC-18(b)	CCI-001441	The organization authorizes wireless access to the information system prior to allowing such connections.	The organization being inspected/assessed authorizes wireless access to the information system prior to allowing such connections.	The organization conducting the inspection/assessment obtains and examines the audit trail of authorizations to ensure the organization being inspected/assessed authorizes wireless access to the information system prior to allowing such connections.	TRUE			X	X					Designer Non-Designer	3.2.3 Wireless and Wired Broadcast Commun...
2473	SI-4	SI-4(a)(1)	CCI-001253	The organization defines the objectives of monitoring for attacks and indicators of potential attacks on the information system.	DoD has defined the monitoring objectives as sensor placement and monitoring requirements within CJCSI 6510.01F.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X	X	X		X				DoD-Defined Enclave Designer Impractical	3.13.3 Information System Monitoring
2478	SI-4	SI-4(b)	CCI-002645	The organization defines the techniques and methods to be used to identify unauthorized use of the information system.	The organization being inspected/assessed defines and documents the techniques and methods to be used to identify unauthorized use of the information system.	The organization conducting the inspection/assessment obtains and examines the documented techniques to ensure the organization being inspected/assessed defines the techniques and methods to be used to identify unauthorized use of the information system.	TRUE		X	X	X					Enclave Designer Non-Designer	3.13.3 Information System Monitoring
2445	SI-3	SI-3(c)(1)	CCI-002623	The organization defines the frequency for performing periodic scans of the information system for malicious code.	DoD has defined the frequency as every 7 days.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X		X		X				DoD-Defined Designer Impractical	3.13.1 Malicious Code Protection
2446	SI-3	SI-3(c)(1)	CCI-001241	The organization configures malicious code protection mechanisms to perform periodic scans of the information system on an organization-defined frequency.	The organization being inspected/assessed configures malicious code protection mechanisms to perform periodic scans of the information system on every 7 days.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures malicious code protection mechanisms to perform periodic scans of the information system on every 7 days.	TRUE		X	X	X					Enclave Designer Non-Designer	3.13.1 Malicious Code Protection
1828	SA-4(10)	SA-4(10)	CCI-003116	The organization employs only information technology products on the FIPS 201-approved products list for Personal Identity Verification (PIV) capability implemented within organizational information systems.	For information system components that have The organization being inspected/assessed employs DoD approved PKI tokens for identity verification.	For information system components that have applicable STIGs or SRGs, the The organization conducting the inspection/assessment examines the information system to ensure DoD approved PKI tokens are implemented for identity verification.	TRUE		X	X		X				Enclave Designer Impractical	3.12 FIPS 201-2 REQUIREMENT
1753	RA-5	RA-5(a)	CCI-001055	The organization defines a frequency for scanning for vulnerabilities in the information system and hosted applications.	DoD has defined the frequency as every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level.	TRUE	X	X	X		X				DoD-Defined Enclave Designer Impractical	3.11 VULNERABILITY SCANNING
1754	RA-5	RA-5(a)	CCI-001054	The organization scans for vulnerabilities in the information system and hosted applications on an organization-defined frequency.	The organization being inspected/assessed will define, document, and implement procedures for vulnerability scans of the information system and hosted applications; and scan for vulnerabilities in the information system and hosted applications every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	The organization conducting the inspection/assessment obtains and examines the organization's vulnerability scanning procedures and results for the 90 days preceding the inspection/assessment.	TRUE		X	X	X					Enclave Designer Non-Designer	3.11 VULNERABILITY SCANNING
1755	RA-5	RA-5(a)	CCI-001056	The organization scans for vulnerabilities in the information system and hosted applications when new vulnerabilities potentially affecting the system/applications are identified and reported.	The organization being inspected/assessed will conduct vulnerability scans of the information system and hosted applications when new vulnerabilities potentially affecting the system/applications are identified and reported via authoritative sources (e.g., IAVM, CTO, DTM, STIG, product vendor).	The organization conducting the inspection/assessment obtains and examines the organization's vulnerability scanning procedures and results in order to validate the organization conducts vulnerability scans of its Information System (IS) and hosted applications when new vulnerabilities potentially affecting the IS and/or applications are identified and reported.	TRUE		X	X	X					Enclave Designer Non-Designer	3.11 VULNERABILITY SCANNING

1756	RA-5	RA-5(a)	CCI-001641	The organization defines the process for conducting random vulnerability scans on the information system and hosted applications.	DoD has defined the requirement for vulnerability scanning periodicity of every 30 days. If the organization being inspected/assessed has determined a requirement for random scanning they must document that process.	The organization conducting the inspection/assessment obtains and examines random vulnerability process documentation (if applicable) to validate the organization has clearly defined and documented a process for conducting random vulnerability scans on the information system and hosted applications.	TRUE		X	X	X	X					Enclave Designer Non-Designer Impractical	3.11 VULNERABILITY SCANNING
1757	RA-5	RA-5(a)	CCI-001643	The organization scans for vulnerabilities in the information system and hosted applications in accordance with the organization-defined process for random scans.	The organization being inspected/assessed will conduct random vulnerability scans every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	The organization conducting the inspection/assessment obtains and examines the vulnerability scanning results every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs) to verify compliance with the organization being inspected/assessed random vulnerability scanning process.	TRUE		X	X	X						Enclave Designer Non-Designer	3.11 VULNERABILITY SCANNING
1758	RA-5	RA-5(b)	CCI-001057	The organization employs vulnerability scanning tools and techniques that facilitate interoperability among tools and automate parts of the vulnerability management process by using standards for: enumerating platforms, software flaws, and improper configurations; formatting checklists and test	The organization being inspected/assessed employs the DoD Enterprise scanning tool.	The organization conducting the inspection/assessment obtains and examines the software list or vulnerability scanning procedures to ensure the organization being inspected/assessed employs the DoD Enterprise scanning tool.	TRUE		X	X	X	X					Enclave Designer Non-Designer Impractical	3.11 VULNERABILITY SCANNING
1759	RA-5	RA-5(c)	CCI-001058	The organization analyzes vulnerability scan reports and results from security control assessments.	The organization being inspected/assessed analyzes vulnerability scan reports and security control assessment results with the intent of identifying legitimate vulnerabilities and the relationship between vulnerabilities and security controls.	The organization conducting the inspection/assessment will interview organizational personnel with security control assessment and vulnerability scanning responsibilities. The purpose of the reviews and interviews is to validate the organization is conducting an analysis of the vulnerability scan reports and results from the security control assessments.	TRUE		X	X	X						Enclave Designer Non-Designer	3.11 VULNERABILITY SCANNING
1760	RA-5	RA-5(d)	CCI-001059	The organization remediates legitimate vulnerabilities in organization-defined response times in accordance with an organizational assessment risk.	The organization being inspected/assessed takes corrective actions as appropriate on legitimate vulnerabilities identified in RA-5, CCI 001058 IAW an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs). Audit records of actions must be maintained IAW applicable DoD, CYBERCOM, and/or component policies.	The organization conducting the inspection/assessment obtains and examines audit records to validate the organization is taking action to remediate legitimate vulnerabilities within the required response times (IAW an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs). The organization conducting the inspection/assessment may conduct independent vulnerability scans to compare those scan results with audit records of remediation actions.	TRUE		X	X	X	X					Enclave Designer Non-Designer Impractical	3.11 VULNERABILITY SCANNING
1549	PE-11	PE-11	CCI-002955	The organization provides a short-term uninterruptible power supply to facilitate an orderly shutdown of the information system and/or transition of the information system to long-term alternate power in the event of a primary power source loss.	The organization being inspected/assessed implements an uninterruptible power supply with sufficient capacity to support orderly shutdown of the system or transition the system to long-term alternate power in the event of a primary power source loss.	The organization conducting the inspection/assessment obtains and examines documentation identifying the capacity of the implemented uninterruptible power supply, documentation identifying the power requirements of the system, and documentation identifying the contingency plan in the event of primary power source loss to ensure the organization being inspected/assessed provides uninterruptible power supply with sufficient capacity to support orderly shutdown of the system or transition the system to long-term alternate power in the event of a primary power source loss.	TRUE		X	X		X	X			X	Enclave Designer Impractical	3.10 DEVICE POWER
1550	PE-11(1)	PE-11(1)	CCI-000961	The organization provides a long-term alternate power supply for the information system that is capable of maintaining minimal required operational capability in the event of an extended loss of the primary power source.	The organization being inspected/assessed will: 1. implement alternate power supply capable of supporting minimal operational capability over the long term. 2. Provide a list of physical IT assets within the boundary of the information system that require a long term alternate power supply. This list may come from the inspected organization's security plan, continuity	The organization conducting the inspection/assessment obtains and examines the list of physical IT assets within the boundary of the information system that require a long term alternate power supply. Physically inspect a sample from the list to ensure that long term power supply capability supporting minimal operational capability has been provided.	TRUE		X	X			X			X	Enclave Designer	3.10 DEVICE POWER
1839	SA-5	SA-5(a)(1)	CCI-003125	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure installation of the system, component, or service.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure installation of the system, component, or service.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide administrator documentation for the information system, system component or information system service that describe secure installation of the system, component, or service.	TRUE			X	X						Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.5 Default Requirements for Control Sy...
1836	SA-5	SA-5(a)(1)	CCI-003124	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure configuration of the system, component, or service.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure configuration of the system, component, or service.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide administrator documentation for the information system, system component or information system service that describe secure configuration of the system, component, or service.	TRUE			X	X						Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.2.1 HVAC Control System Devices FULLY S... 1.9.8.2.2 All Other HVAC Control System Devic... 1.9.8.3.1 Lighting Control System Devices FUL... 1.9.8.3.2 All Other Lighting Control System D... 1.9.8.5 Default Requirements for Control Sy...
1837	SA-5	SA-5(a)(3)	CCI-003128	The organization obtains administrator documentation for the information system, system component, or information system services that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide administrator documentation for the information system, system component or information system service that describe known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions.	TRUE			X	X						Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.1 Software Applications 1.9.8.2.1 HVAC Control System Devices FULLY S... 1.9.8.2.2 All Other HVAC Control System Devic... 1.9.8.3.1 Lighting Control System Devices FUL... 1.9.8.3.2 All Other Lighting Control System D...
1840	SA-5	SA-5(b)(1)	CCI-003129	The organization obtains user documentation for the information system, system component, or information system service that describes user-accessible security functions/mechanisms and how to effectively use those security functions/mechanisms.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide user documentation for the information system, system component or information system service that describes user-accessible security functions/mechanisms and how to effectively use those security functions/mechanisms.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide user documentation for the information system, system component or information system service that describes user-accessible security functions/mechanisms and how to effectively use those security functions/mechanisms.	TRUE			X	X						Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.1 Software Applications 1.9.8.2.1 HVAC Control System Devices FULLY S... 1.9.8.2.2 All Other HVAC Control System Devic... 1.9.8.3.1 Lighting Control System Devices FUL... 1.9.8.3.2 All Other Lighting Control System D...
1838	SA-5	SA-5(b)(2)	CCI-003130	The organization obtains user documentation for the information system, system component or information system service that describes methods for user interaction which enables individuals to use the system, component, or service in a more secure manner.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide user documentation for the information system, system component or information system service that describes methods for user interaction which enables individuals to use the system, component, or service in a more secure manner.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide user documentation for the information system, system component or information system service that describes methods for user interaction which enables individuals to use the system, component, or service in a more secure manner.	TRUE			X	X						Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.1 Software Applications 1.9.8.2.1 HVAC Control System Devices FULLY S... 1.9.8.2.2 All Other HVAC Control System Devic... 1.9.8.3.1 Lighting Control System Devices FUL... 1.9.8.3.2 All Other Lighting Control System D...
1842	SA-5	SA-5(a)(2)	CCI-003127	The organization obtains administrator documentation for the information system, system component, or information system services that describes effective use and maintenance of security functions/mechanisms.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe effective use and maintenance of security functions/mechanisms.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide administrator documentation for the information system, system component or information system service that describe effective use and maintenance of security functions/mechanisms.	TRUE			X	X						Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.1 Software Applications 1.9.8.2.1 HVAC Control System Devices FULLY S... 1.9.8.2.2 All Other HVAC Control System Devic... 1.9.8.3.1 Lighting Control System Devices FUL... 1.9.8.3.2 All Other Lighting Control System D... 1.9.8.5 Default Requirements for Control Sy...
1841	SA-5	SA-5(b)(3)	CCI-003131	The organization obtains user documentation for the information system, system component or information system service that describes user responsibilities in maintaining the security of the system, component, or service.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide user documentation for the information system, system component or information system service that describes user responsibilities in maintaining the security of the system, component, or service.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide user documentation for the information system, system component or information system service that describes user responsibilities in maintaining the security of the system, component, or service.	TRUE			X	X						Designer Non-Designer	1.9.8 Control System Cybersecurity Docume... 1.9.8.1 Software Applications
1835	SA-5	SA-5(a)(1)	CCI-003126	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure operation of the system, component, or service.	The organization being inspected/assessed documents within contracts/agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure operation of the system, component, or service.	The organization conducting the inspection/assessment obtains and examines the contracts/agreements to ensure the organization being inspected/assessed requires that the developer provide administrator documentation for the information system, system component or information system service that describe secure operation of the system, component, or service.	TRUE			X	X						Designer Non-Designer	1.9.8 Control System Cybersecurity Docume...
1629	PL-2	PL-2(a)(2)	CCI-003051	The organization's security plan for the information system explicitly defines the authorization boundary for the system.	The organization being inspected/assessed explicitly defines within the security plan the authorization boundary for the system.	The organization conducting the inspection/assessment obtains and examines the security plan to ensure the organization being inspected/assessed explicitly defines within the security plan the authorization boundary for the system.	TRUE		X	X	X						Enclave Designer Non-Designer	1.9.6 Cybersecurity Riser Diagram

1630	PL-2	PL-2(a)(4)	CCI-003053	The organization's security plan for the information system provides the security categorization of the information system including supporting rationale.	The organization being inspected/assessed defines within the security plan the security categorization of the information system including supporting rationale.	The organization conducting the inspection/assessment obtains and examines the security plan to ensure the organization being inspected/assessed defines within the security plan the security categorization of the information system including supporting rationale.	TRUE			X	X						Designer Non-Designer	1.9.6 Cybersecurity Riser Diagram
1017	CP-10	CP-10	CCI-000550	The organization provides for the recovery and reconstitution of the information system to a known state after a disruption.	The organization being inspected/assessed provides automated mechanisms or manual procedures, or a combination of the two, for the recovery and reconstitution of its information system to a known state after a disruption.	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it identifies the recovery and reconstitution method for its information system to a known state after a disruption.	TRUE		X	X	X						Enclave Designer Non-Designer	1.9.5 Software and Configuration Backups
1018	CP-10	CP-10	CCI-000551	The organization provides for the recovery and reconstitution of the information system to a known state after a compromise.	The organization being inspected/assessed provides automated mechanisms or manual procedures, or a combination of the two, for the recovery and reconstitution of its information system to a known state after a compromise. The organization must identify the selected method in the contingency plan.	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it identifies the recovery and reconstitution method for its information system to a known state after a compromise.	TRUE		X	X	X						Enclave Designer Non-Designer	1.9.5 Software and Configuration Backups
1019	CP-10	CP-10	CCI-000552	The organization provides for the recovery and reconstitution of the information system to a known state after a failure.	The organization being inspected/assessed provides automated mechanisms or manual procedures, or a combination of the two, for the recovery and reconstitution of its information system to a known state after a failure. The organization must identify the selected method in the contingency plan.	The organization conducting the inspection/assessment obtains and examines the contingency plan to ensure it identifies the recovery and reconstitution method for its information system to a known state after a failure.	TRUE		X	X	X						Enclave Designer Non-Designer	1.9.5 Software and Configuration Backups
2661	SI-17	SI-17	CCI-002773	The organization defines the fail-safe procedures to be implemented by the information system when organization-defined failure conditions occur.	The organization being inspected/assessed defines and documents the fail-safe procedures to be implemented by the information system when organization-defined failure conditions occur. DoD has determined the fail-safe procedures are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented fail-safe procedures to ensure the organization being inspected/assessed defines the fail-safe procedures to be implemented by the information system when organization-defined failure conditions occur. DoD has determined the fail-safe procedures are not appropriate to define at the Enterprise level.	TRUE			X							Designer	1.9.4 Control System Inventory Report 3.8 SAFE MODE AND FAIL SAFE OPERATION

2662	SI-17	SI-17	CCI-002774	The organization defines the failure conditions which, when they occur, will result in the information system implementing organization-defined fail-safe procedures.	The organization being inspected/assessed defines and documents the failure conditions which, when they occur, will result in the information system implementing organization-defined fail-safe procedures. DoD has determined the failure conditions are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented failure conditions to ensure the organization being inspected/assessed defines the failure conditions which, when they occur, will result in the information system implementing organization-defined fail-safe procedures. DoD has determined the failure conditions are not appropriate to define at the Enterprise level.	TRUE			X						Designer	1.9.4 Control System Inventory Report 3.8 SAFE MODE AND FAIL SAFE OPERATION
2663	SI-17	SI-17	CCI-002775	The information system implements organization-defined fail-safe procedures when organization-defined failure conditions occur.	The organization being inspected/assessed configures the information system to implement fail-safe procedures defined in SI-17, CCI 2773 when failure conditions defined in SI-17, CCI 2774 occur. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI 2775.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to implement fail-safe procedures defined in SI-17, CCI 2773 when failure conditions defined in SI-17, CCI 2774 occur. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs pertaining to CCI 2775.	TRUE			X						Designer	1.9.4 Control System Inventory Report 3.8 SAFE MODE AND FAIL SAFE OPERATION
1074	IA-3	IA-3	CCI-000777	The organization defines a list of specific and/or types of devices for which identification and authentication is required before establishing a connection to the information system.	DoD has defined the value as all mobile devices and network connected endpoint devices (including but not limited to: workstations, printers, servers (outside a datacenter), VoIP Phones, VTC CODECs).	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the value as all mobile devices and network connected endpoint devices (including but not limited to: workstations, printers, servers (outside a datacenter), VoIP Phones, VTC CODECs) before	TRUE	X	X	X		X				DoD-Defined Enclave Designer Impractical	1.9.4 Control System Inventory Report 3.2.7 Device Identification and Authentic...
1075	IA-3	IA-3	CCI-000778	The information system uniquely identifies an organization defined list of specific and/or types of devices before establishing a local, remote, or network connection.	The organization being inspected/assessed configures the network infrastructure to identify all mobile devices and network connected endpoint devices (including but not limited to: workstations, printers, servers (outside a datacenter), VoIP Phones, VTC CODECs) before	The organization conducting the inspection/assessment examine a sampling of the network infrastructure device configurations to ensure devices connecting to the infrastructure are uniquely identified. For information system components that have applicable STIGs or SRGs, the	TRUE		X	X		X				Enclave Designer Impractical	1.9.4 Control System Inventory Report 3.2.7 Device Identification and Authentic...
1076	IA-3	IA-3	CCI-001958	The information system authenticates an organization defined list of specific and/or types of devices before establishing a local, remote, or network connection.	The organization being inspected/assessed configures the network infrastructure to authenticate all mobiles devices and network connected endpoint devices (including but not limited to: workstations, printers, servers (outside a datacenter), VoIP Phones, VTC CODECs) before establishing a local, remote, network connection.	The organization conducting the inspection/assessment examine a sampling of the network infrastructure device configurations to ensure devices connecting to the infrastructure are uniquely authenticated. For information system components that have applicable STIGs or SRGs, the organization conducting the inspection/assessment evaluates the components to ensure that the organization being inspected/assessed has configured the information system in compliance with the applicable STIGs and SRGs	TRUE		X	X		X				Enclave Designer Impractical	1.9.4 Control System Inventory Report 3.2.7 Device Identification and Authentic...
824	CM-8	CM-8(a)(1)	CCI-000389	The organization develops and documents an inventory of information system components that accurately reflects the current information system.	The organization being inspected/assessed documents inventory of information system components that accurately reflects the current information system.	The organization conducting the inspection/assessment obtains and examines the documented inventory and examines a sampling of information system components to ensure inventory accurately reflects the current information system.	TRUE			X						Designer	1.9.4 Control System Inventory Report
825	CM-8	CM-8(a)(2)	CCI-000392	The organization develops and documents an inventory of information system components that includes all components within the authorization boundary of the information system.	The organization being inspected/assessed documents inventory of information system components that includes all components within the authorization boundary of the information system.	The organization conducting the inspection/assessment obtains and examines the documented inventory and examines a sampling of information system components to ensure inventory includes all components within the authorization boundary of the information system.	TRUE			X						Designer	1.9.4 Control System Inventory Report
826	CM-8	CM-8(a)(4)	CCI-000398	The organization defines information deemed necessary to achieve effective information system component accountability.	DoD has defined the information as hardware inventory specifications (manufacturer, type, model, serial number, physical location), software license information, information system/component owner, and for a networked component/device, the machine name.	The organization being inspected/assessed is automatically compliant with this CCI because they are covered at the DoD level. DoD has defined the information as hardware inventory specifications (manufacturer, type, model, serial number, physical location), software license information, information system/component owner, and for a networked	TRUE	X		X	X	X				DoD-Defined Designer Non-Designer Impractical	1.9.4 Control System Inventory Report
677	CA-9	CA-9(b)	CCI-002103	The organization documents, for each internal connection, the interface characteristics.	The organization being inspected/assessed documents, for each internal connection, the interface characteristics.	The organization conducting the inspection/assessment obtains and examines the documented interface characteristics as well as the network topology to ensure the organization being inspected/assessed documents, for each internal connection, the interface characteristics.	TRUE			X						Designer	1.9.3 Network Communication Report
678	CA-9	CA-9(b)	CCI-002104	The organization documents, for each internal connection, the security requirements.	The organization being inspected/assessed documents, for each internal connection, the security requirements.	The organization conducting the inspection/assessment obtains and examines the documented security requirements as well as the network topology to ensure the organization being inspected/assessed documents, for each internal connection, the security requirements.	TRUE			X						Designer	1.9.3 Network Communication Report
679	CA-9	CA-9(b)	CCI-002105	The organization documents, for each internal connection, the nature of the information communicated.	The organization being inspected/assessed documents, for each internal connection, the nature of the information communicated.	The organization conducting the inspection/assessment obtains and examines the documented nature of information communication as well as the network topology to ensure the organization being inspected/assessed documents, for each internal connection, the nature of the information communicated.	TRUE			X						Designer	1.9.3 Network Communication Report

680	CA-9	CA-9(a)	CCI-002102	The organization defines the information system components or classes of components that that are authorized internal connections to the information system.	The organization being inspected/assessed defines and documents the information system components or classes of components that that are authorized internal connections to the information system. DoD has determined the information system components are not appropriate to define at the Enterprise level.	The organization conducting the inspection/assessment obtains and examines the documented information system components to ensure the organization being inspected/assessed defines the information system components or classes of components that that are authorized internal connections to the information system. DoD has determined the information system components are not appropriate to define at the Enterprise level.	TRUE			X							Designer	1.9.3 Network Communication Report
631	CA-3	CA-3(b)	CCI-000258	The organization documents, for each interconnection, the interface characteristics.	The organization being inspected/assessed will document the interface characteristics for each interconnection. Use of external reporting databases for these characteristics when tied to the specific interconnection is acceptable (e.g., ports, protocols, and services). Policy Note: Interconnection security agreements are required for	The organization conducting the inspection/assessment obtains and examines interconnection security agreement documentation. Policy Note: Interconnection security agreements are required for systems connecting between enclaves that require the hosting enclave to enable PPS outside of their already established and approved business practices. Connections can include both DoD enclaves or non DoD enclaves.	TRUE		X	X	X						Enclave Designer Non-Designer	1.9.2 Cybersecurity Interconnection Sched... 1.11 CYBERSECURITY DURING CONSTRUCTION
692	CM-2	CM-2	CCI-000293	The organization develops and documents a current baseline configuration of the information system.	The organization being inspected/assessed develops and documents a current baseline configuration of the information system.	The organization conducting the inspection/assessment obtains and examines the documented baseline configuration.	TRUE			X							Designer	---
1107	IA-5	IA-5(b)	CCI-000176	The organization manages information system authenticators by establishing initial authenticator content for authenticators defined by the organization.	The organization being inspected/assessed defines and documents procedures for setting initial authenticator content.	The organization conducting the inspection/assessment obtains and examines the documented procedures for setting initial authenticator content to ensure they have been defined.	TRUE			X	X						Designer Non-Designer	---
1744	RA-3	RA-3(a)	CCI-001048	The organization conducts an assessment of risk of the information system and the information it processes, stores, or transmits that includes the likelihood and magnitude of harm from the unauthorized access, use, disclosure, disruption, modification, or destruction.	The organization being inspected/assessed conducts an assessment of risk of the information system and the information it processes, stores, or transmits that includes the likelihood and magnitude of harm from the unauthorized access, use, disclosure, disruption, modification, or destruction.	The organization conducting the inspection/assessment obtains and examines the audit trail of assessments to ensure the organization being inspected/assessed conducts an assessment of risk of the information system and the information it processes, stores, or transmits that includes the likelihood and magnitude of harm from the unauthorized access, use,	TRUE			X	X						Designer Non-Designer	---
2367	SC-39	SC-39	CCI-002530	The information system maintains a separate execution domain for each executing process.	The organization being inspected/assessed configures the information system to maintain a separate execution domain for each executing process.	The organization conducting the inspection/assessment examines the information system to ensure the organization being inspected/assessed configures the information system to maintain a separate execution domain for each executing process.	TRUE			X							Designer	---
2686	PM-5	PM-5	CCI-000207	The organization develops and maintains an inventory of its information systems.	DITPR is the inventory for all DoD information systems. The organization being inspected/assessed must register and maintain their information systems in DITPR.	DITPR is the inventory for all DoD information systems. The organization conducting the inspection/assessment obtains and examines the inventory of information systems via DITPR to ensure the organization being inspected/assessed registers their information systems in DITPR.	TRUE			X	X	X					Designer Non-Designer Impractical	---
2703	PM-11	PM-11(b)	CCI-000236	The organization determines information protection needs arising from the defined mission/business processes and revises the processes as necessary, until an achievable set of protection needs are obtained.	The organization being inspected/assessed determines information protection needs IAW CNSSI 1253 and as identified in RA-2.	The organization conducting the inspection/assessment obtains and examines the security plan to ensure the security categorization has been documented IAW CNSSI 1253.	TRUE		X	X	X						Enclave Designer Non-Designer	---

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 26 05 13

MEDIUM-VOLTAGE CABLES

08/25

PART 1 GENERAL

DSSC DLA Repair Building 27, Contract No.: W912QR24D0008, replacement of existing transformers serving building 27. Provide new pole mounted medium voltage switch to allow for disconnecting from overhead medium voltage distribution lines. Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION applies to work specified in this section.

1.1 DEFINITIONS

Medium-voltage power cables include all cables rated above 2,000 volts up to 35,000 volts.

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.

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2013; R 2024) Standard Specification for Soft or Annealed Copper Wire
ASTM B8	(2023) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	(2010; R 2020) Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM D746	(2024) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 48	(2020) Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
IEEE 386	(2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
IEEE 400	(2023) Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

IEEE 400.2	(2024) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)
IEEE 404	(2012) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
IEEE 1202	(2006; R 2012; CORR 1 2012) Flame-Propagation Testing of Wire and Cable
IEEE C2	(2023) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA T-29-520	(1986) Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input Rate of 210,000 B.T.U./Hour
---------------	---

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
----------	--

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1	(2023) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI/NEMA WC 71/ICEA S-96-659	(2014; R 2022) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA WC 74/ICEA S-93-639	(2022) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 1 2024; TIA 24-1; TIA 25-2) National Electrical Code
NFPA 70E	(2024) Standard for Electrical Safety in the Workplace

UL SOLUTIONS (UL)

UL 1581	(2019; Reprint Nov 2023) UL Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords
UL 1685	(2015) UL Standard for Safety Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 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

List of Splices and Terminations to be Installed by
Splicer/Terminator;

SD-02 Shop Drawings

Pulling Plan;

SD-03 Product Data

Single-Conductor Shielded Cables;

Ground Conductors;

Cable Supports and Fittings;

Cable Grips;

Cable Tags;

Fireproof Tape;

Splices;

Terminations;

Metal-Clad and Armored Cable;

Jumper Cables;

Cable Identification;

SD-05 Design Data

Submit within 90 calendar days of Notice to Proceed.

Cable Pulling Calculations;

Cleat Manufacturer's Calculations;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SD-06 Test Reports

Factory Inspection and Tests;
Field Acceptance Testing;
Wire And Cable Test Record Form;
Phase Rotation Test Record Form;

SD-07 Certificates

Splicer/Terminator Certifications;

SD-08 Manufacturer's Instructions

Terminations;
Splices;

1.4 ADMINISTRATIVE REQUIREMENTS

1.4.1 Pre-Installation Meetings

No later than 30 days after Notice to Proceed, coordinate with the Contracting Officer to schedule a pre-installation meeting. Submit the following for review and approval prior to the meeting:

- a. Pulling Plan. Do not perform any pull until Government reviews and approves the pulling plan, pulling calculations, and cable factory test certificates.
- b. Splicer/Terminator Certifications
- c. List of Splices and Terminations to be Installed by Splicer/Terminator
- d. Manufacturer's catalog data for all cables, cable supports and fittings, cable tags, fireproof tape, splice kits, terminations, and any other product data required to complete the work.

1.5 QUALITY CONTROL

1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Ensure equipment, materials, installation, and workmanship are in accordance with the mandatory and advisory provisions of NFPA 70, IEEE C2 unless more stringent requirements are specified or indicated.

1.5.2 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. Provide products which have been in satisfactory commercial or industrial use for 2 years prior to bid

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

opening. Ensure the 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has 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 must be products of a single manufacturer.

1.5.3 Qualifications`

Verify personnel performing Medium Voltage (MV) splicing or terminations have 5 years minimum experience in cable splicing and terminations of the type used in this project. Submit splicer/terminator certifications issued by the cable splice and termination manufacturer who has examined and tested a test splice or termination of each type required by this contract for each cable splicer. Ensure the certification identifies which splices and terminations it applies to. Require each individual, certified or not, with the required medium voltage splicing and terminating experience, who is to perform cable splicing or terminating, to perform a minimum of one splice or termination of each type in the presence of the manufacturer's and Government's representative. Supply all materials and tools required for the demonstration splices and terminations. Submit each splice or termination performed by individuals without manufacturer's certification to the manufacturer for testing and subsequent certification.

Once a splice or termination has been started by a splicer, ensure the same splicer completes that particular splice, and that each termination and splice is started and completed in one continuous work period.

Maintain and submit a list of splices and terminations to be installed by splicer/terminator. Ensure the list includes the following for each splice or termination completed.

- a. Name of splicer/terminator.
- b. Date splice or termination was performed.
- c. Location of splice or termination. For terminations at equipment indicate equipment number as required to completely define the location.
- d. Feeder number, as applicable.

1.6 FACTORY INSPECTION AND TESTS

1.6.1 General

Perform factory inspection and tests of wire and cable by and at the plant of the manufacturer. Ensure testing complies with Section 7 of ANSI/NEMA WC 71/ICEA S-96-659 and Section 9 of NEMA WC 74/ICEA S-93-639 as applicable. Include specific tests required for particular materials, components, and completed cables as specified in the sections of the above standards applicable to those materials, components, and cable types. Also perform tests in accordance with the additional requirements specified below. In addition to the manufacturer's routine sample testing, for each reel perform an insulation resistance test, and a shield continuity test as applicable. Do not ship cable until after the manufacturer's test reports have been submitted and approved.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.6.2 Flame Tests

Provide multiple-conductor and single-conductor cable assemblies for cable trays and risers that have passed IEEE 1202 (FT4), UL 1685, or ICEA T-29-520 flame tests. For all other single-conductor cables and individual conductors of multiple-conductor cables, provide cables that have at least passed UL 1581 (VW-1 or FT1) flame tests. If such tests have previously been performed on identical cables of the same design and is indicated in the product data, these tests need not be repeated.

1.7 DELIVERY, STORAGE, AND HANDLING

a. Ship cables on reels in a way that protects the cable from mechanical injury. Hermetically seal end of each cable length using heat-shrinkable molded cable end caps to exclude moisture and securely attached to the reel.

b. Store cables on reels with the axis hole parallel to the horizontal plane. Cables on reels stored laying flat on the side of the reel will not be accepted. Roll reels in the direction indicated by the manufacturer.

c. Make the minimum reel drum diameter a minimum of 14 times the overall diameter of the cable. Ensure that each cable length is installed with a pulling eye installed by the manufacturer, for installation in ducts, manholes, and utility tunnels.

d. Unreel or uncoil cables slowly to prevent damage to the sheath by sudden bending. Stop unreeling or uncoiling if kinks appear and do not proceed until kinks have been removed. Kinked cable will be rejected. Improperly handled cable may be rejected.

PART 2 PRODUCTS

2.1 MEDIUM-VOLTAGE CABLE

2.1.1 Wire and Cable Schedule

Provide cable in accordance with the requirements of the Conduit and Cable Schedules, and as indicated on the drawings. Estimated quantities shown on the drawings are approximate for bidding purposes and must be verified by the Contractor.

2.1.2 Governing Standards

Provide materials, construction, and tests, unless otherwise specified, conforming to the applicable requirements of ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639 as applicable, for the following:

a. Single-Conductor Shielded Cables

2.2 MATERIALS

2.2.1 Submittal Requirements

Submit catalog data sufficient to demonstrate compliance with the specifications requirements for all cable types provided.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.2 Rated Circuit Voltages

Provide cables with minimum rated circuit voltages in accordance with ANSI/NEMA WC 71/ICEA S-96-659, and NEMA WC 74/ICEA S-93-639 as applicable.

2.2.3 Conductors

2.2.3.1 Material for Conductors

Provide conductors that in accordance with Section 2 of ANSI/NEMA WC 71/ICEA S-96-659, and NEMA WC 74/ICEA S-93-639, annealed copper conforming to ASTM B3 or ASTM B8 unless specified otherwise. Copper conductors must be bare, or tin- or lead-alloy-coated, if required by the type of insulation used. Tin-coated copper conductors must conform to ASTM B33.

2.2.3.2 Conductor Size

Minimum wire sizes are No. 6 AWG for 5kV cable and and No. 2 AWG for 15kV cable.

2.2.3.3 Stranding

Provide class B stranding as defined in Table G-2 of ANSI/NEMA WC 71/ICEA S-96-659, and Table H-2 of NEMA WC 74/ICEA S-93-639, as applicable.

2.2.4 Insulation

2.2.4.1 Insulation Material

Except as otherwise specified, provide cross-linked thermosetting type (XLPE or XLPO) or an ethylene-propylene rubber (EPR) type insulation meeting the requirements of Section 4 of ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639 as applicable. Polyvinyl Chloride (PVC) insulation will not be accepted.

2.2.4.2 Insulation Thickness

Provide minimum insulation thickness for each conductor based on its rated voltage and insulation material for 133 percent insulation levels. For both single-conductor cables and individual conductors of multiconductor cables, provide insulation thickness per Table 4-2 of ANSI/NEMA WC 71/ICEA S-96-659 and per Table 4-4 of NEMA WC 74/ICEA S-93-639 as applicable. Thicknesses shown below are nominal, ranging from -5 mils below nominal to +30 mils above nominal. Acceptable nominal thicknesses are:

Voltage Rating (kV)	Insulation Level (percent)	Typical Insulation Thickness	
		mm	mils
2.4	100	Depends on conductor size, see Table 4-2, NEMA WC 71	
	133	Depends on conductor size, see Table 4-2, NEMA WC 71	

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Voltage Rating (kV)	Insulation Level (percent)	Typical Insulation Thickness	
		mm	mils
5	100	2.29	90
	133	2.92	115
	173	3.56	140
8	100	2.92	115
	133	3.56	140
	173	4.45	175
15	100	4.45	175
	133	5.59	220
	173	6.6	260
25	100	6.6	260
	133	8.13	320
	173	10.67	420
35	100	8.76	345
	133	10.67	420
	173	14.73	580

2.2.4.3 Insulation Shielding

Provide shielding that complies with Sections 5 and 6 of NEMA WC 74/ICEA S-93-639 for all cables rated 5kV and higher.

2.2.5 Jackets

Provide jackets meeting the requirements of Section 5.1 of ANSI/NEMA WC 71/ICEA S-96-659 and Section 7.1 of NEMA WC 74/ICEA S-93-639 as applicable for all cables. Individual conductors of multiple-conductor cables are required to have jackets only if they are necessary for the conductor to meet other specifications herein. For single-conductor cables and individual conductors of multiple-conductor cables, except for shielded cables, provide jackets in direct contact and adhered or vulcanized to the conductor insulation. For multiple-conductor cables and shielded single-conductor cables, provide a common overall jacket, tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.5.1 Jacket Material

Provide jackets of one of the materials listed below, in accordance with Section 5 of ANSI/NEMA WC 71/ICEA S-96-659 and Section 7 of NEMA WC 74/ICEA S-93-639 as applicable. Polyvinyl chloride compounds will not be permitted.

- a. Black neoprene (CR).
- b. Chlorosulfonated polyethylene (CSPE)
- c. Chlorinated polyethylene (CPE)
- d. Low smoke zero halogen (LSZH)
- e. Crosslinked polyolefin (XLPO)
- f. Medium-density polyethylene (MDPE)

2.2.5.2 Jacket Thickness

Ensure the minimum thickness of the jackets at any point is not less than 80 percent of the nominal thicknesses specified in Tables 5-2 and 5-3 of ANSI/NEMA WC 71/ICEA S-96-659 and Table 7-4 of NEMA WC 74/ICEA S-93-639 as applicable.

2.2.6 Cabling

Assemble individual conductors of multiple-conductor cables with flame-and moisture-resistant fillers, binders, and a lay in accordance with Section 8 of NEMA WC 74/ICEA S-93-639 as applicable. Provide non-hygroscopic fillers compatible with the cable insulation, jacket, and other components of the cable in the interstices of multiple-conductor round cables, with a common covering where necessary to give the completed cable a substantially circular cross section. Provide rubber-filled or other approved type of binding tape that is compatible with the other components of the cable and lapped at least 10 percent of its width.

2.2.7 Dimensional Tolerance

Ensure outside diameters of single-conductor cables and of multiple-conductor cables do not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

2.2.8 Cable Identification

Provide cables with printing on the outer jacket showing the name of the manufacturer, conductor size and material, type of insulation and nominal thickness, and the year in which the cable was manufactured. Closely group the information on the tape at 3.3-foot (1 meter) maximum intervals to permit complete identification.

2.3 SPECIAL WIRE AND CABLE

2.3.1 Ground Conductors

Provide ground conductors that are bare, soft-drawn, Class A or B stranded copper cables sized in accordance with NFPA 70, or NEMA WC 74/ICEA S-93-639 Section 8 as applicable. The ground conductor may be integral to a

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3-conductor cable assembly where applicable.

2.4 SPLICES, CONNECTIONS, AND TERMINATIONS

2.4.1 Load Break and Nonload Break Connectors

Provide and nonload-break terminations that comply with IEEE 386 requirements where the drawings indicate plug-type field connections to equipment terminals, or where otherwise specified. Provide connector with a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material. Ensure connections are compatible with equipment bushings.

2.4.2 Splices

Provide heat shrink splice kits which are the product of a single manufacturer. Ensure the power cable splice meets the requirements of IEEE 404 for a 15 kV rating, and are rated by the manufacturer for use on 15kV class cable systems. Ensure splices are rated for continuous operation at 221 degrees F, with an emergency overload temperature rating of 284 degrees F. Ensure the kit is capable of splicing cables with copper conductors sized as indicated in the contract drawings or accommodate a conductor size transition. Provide splices specifically designed for the cable and grounding provisions.

Provide heat shrink splices which include but are not limited to the following:

- a. Inner heat shrink stress control tube with external end sealant, additional heat shrink tube over inner tube and inner tube end sealant.
- b. Heat shrink outer wraparound sleeve with heat sensitive indications on both the tube and rail/channel area to indicate proper torch heating, stress relief material, mastic, sealant, shielding mesh, and silicone grease.

2.4.3 Terminations

Provide Class 1A terminations per IEEE 48.

2.5 SUPPORTS, TAGS, AND ACCESSORIES

2.5.1 Cable Supports and Fittings

Provide cable supports, related fittings, and accessories for use in corrosive underground locations, such as manholes and utility tunnels, with a factory-applied coating of PVC of at least 20 mils thick. Provide PVC coated items that have a uniform thickness and are free of blisters, breaks, and holidays. Provide PVC compound that conforms to ASTM D746.

2.5.2 Cable Tags

Provide cable identification tags of polyethylene or polypropylene that are non-corrosive. Ensure tags are resistive to acids, alkalis, organic solvents, salt water, and are distortion resistant to 149 degrees C. Tags must be suitable for contact with the type of insulation or jacket

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

material used, and be composed of block letters, numbers, and symbols 1 inch high on a yellow background. Ensure letters, numbers, and symbols do not fall off or change positions regardless of the cable tags orientation. Markings must have been tested by an independent testing laboratory or by the manufacturer to indicate that the markings will not stain or discolor when subjected to an accelerated aging test while in contact with the cable materials and ultraviolet light exposure. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ensure ties have a minimum loop tensile strength of 175 pounds.

2.5.3 Fireproof Tape

Provide fireproof tape approximately 30 mils thick by 3 inches wide, consisting of a flexible, unsupported elastomer that expands in fire to provide a thick char buildup between the flame and the cable. Ensure the tape does not give off a smoke when subjected to flames or support combustion. Also, ensure tape does not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Install medium-voltage cables in accordance with NFPA 70, NFPA 70E; and IEEE C2. Refer to contract provisions for safety submittals and requirements associated with working in the vicinity of energized cables and equipment. The use of arc-flash and shock prevention equipment and personal protective equipment is mandatory. Prior to starting work on a medium-voltage cable system, the Contractor must identify and tag the phasing of equipment with a phase rotation meter, and submitting a Phase Rotation Test Record Form. The Contractor is responsible for maintaining the phasing, and matching the existing phase rotation and phasing when installing conductors in existing electrical systems. Install the cables in the following locations:

Exterior:

- a. In underground duct banks
- b. In conduit above and below grade
- c. In manholes
- d. By direct burial

Inside Buildings:

- a. In conduits, exposed or embedded/concealed
- b. On insulator hooks
- c. On racks
- d. In wall-mounted and ceiling-mounted mounted cable trays

Secure cables with heavy-duty cable ties in existing or new trays mounted horizontally, where the cable rests on the tray bottom. Install cable

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ties at a minimum of 10 foot intervals. Secure cables with PVC-coated cable clamps, straps, hangers, or other approved supporting devices to tunnel walls and ceilings, where not installed in cable trays. Immediately seal cut ends of cables cut in the field to prevent entrance of moisture with heat-shrinkable molded cable end caps.

3.1.2 Cable Pulling Calculations

Cable pulling calculations must be performed by the cable manufacturer's Field Engineer or by another qualified engineer and approved by the cable manufacturer's Field Engineer. Provide calculations that show the cable manufacturer's maximum allowed pulling force and maximum allowed sidewall pressure are not exceeded, and that cables do not require splices. If the calculations show that a splice is required at any point to avoid damage to the cable, immediately bring to the attention of the Government.

3.1.3 Pulling Cables in Conduits, Ducts, Manholes and Utility Tunnels

Thoroughly clean ducts before installation of power cables. Pull a standard flexible mandrel through each duct to loosen particles of earth, sand, or foreign material in the line. Use a mandrel that is not less than 12 inches long with a diameter 1/2 inch less than the inside diameter of the duct. Then pull a brush with stiff bristles through each duct to remove the loosened particles. Use a brush with a diameter that is the same as or slightly larger than the diameter of the duct. Cable pulling using a vehicle is not be permitted.

Submit a Pulling Plan including staging provisions, known splice or termination points, calculations of pulling tension and side wall pressure anticipated, the maximum allowable pulling tension for each pull, and the method of measuring pulling tension throughout the pull. Do not perform any pull until Government reviews and approves the pulling plan and the cable pulling calculations. Cables may only be pulled manually, or by use of a tugger designed for cable pulling. Either method must employ a dynamometer to measure pulling tension throughout the pull.

3.1.3.1 Staging

Pull medium-voltage cables into ducts and utility tunnels with equipment designed for this purpose, including a power-driven winch, cable-feeding flexible tube guide, cable grips, and lubricants. Employ a sufficient number of trained personnel and equipment to ensure correct installation of the cable.

Set up the cable reel at the side of the manhole or tunnel hatch opening and above the duct or hatch level, allowing the cable to enter through the opening without reverse bending. Install a flexible tube guide through the opening in a manner that prevents the cable from rubbing against the edges of structural members.

3.1.3.2 Allowable Sidewall Pressure

The allowable sidewall pressure is the smaller of 500 pounds per foot of bend radius for 5-15kV shielded cable, 300 pounds per foot for interlocked armored cable and cable rated above 15kV, or the cable manufacturer's recommended maximum value. Show in the pulling plan submittal the calculations for allowable tension and sidewall pressure as well as the anticipated tension and sidewall pressure for each pull in the project.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Unreel cable from the top of the reel, carefully controlling payout. Attach cable to be pulled through a swivel to the main pulling wire by means of a suitable cable grip permitted only on cables less than 200 feet long and less than 2 inches in diameter. Attach pulling eyes to the cable conductors of the 3-1/c circuit to prevent damage to the cable structure. Pull the entire 3-1/c circuit simultaneously.

3.1.3.3 Minimum Bending Radius

Minimum bending radius during cable pulling operations is 30 inches. For permanent cable bending the minimum bending radius is 12 times cable diameter.

3.1.3.4 Coating of Cables

Liberally coat cables with a suitable cable-pulling lubricant as it enters the tube guide or duct. Do not use greaser and oil lubricants. Cover nonmetallic sheathed cables with wire-pulling compounds, when required, which have no deleterious effects on the cable. Use rollers, sheaves or tube guides, around which the cable is pulled, conforming to the 30 inches minimum bending radius of the cable during the pulling operations.

3.1.3.5 Pulling Speed

Pull cables into ducts at a speed not to exceed 50 feet per minute and not in excess of maximum permissible pulling tension specified by the cable manufacturer. Stop pulling operations immediately with any indication of binding or obstruction and do not resume until such difficulty is corrected. Provide sufficient slack for free movement of cable due to expansion or contraction.

3.1.4 Ventilation

Provide a blower to force fresh air into manholes or confined areas where free movement or circulation of air is obstructed.

3.1.4.1 Moisture Control and Water Intrusion

Have waterproof protective coverings available on the work site to protect against moisture while a splice is being made. Use pumps to keep manholes dry during splicing operations. Never make a splice or termination with the interior of a cable exposed to moisture. Use a manhole ring at least 6 inches above ground around the manhole entrance to keep surface water from entering the manhole. Before starting the splice, plug unused ducts and stop water seepage through ducts in use.

3.1.5 Splices

Make splices in manholes or tunnels except where cable terminations are specifically indicated. Expedite splicing and terminating of cables in order to minimize exposure and cable deterioration. If cable splices in the tunnel are not installed in cable trays, install the cable splices on cable racks or by other approved methods that minimize physical stress on the splice connections. Support splices at approximately the same elevation as the installed cable except where space limitations or existing cable length limitations make this method impractical or impossible.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.5.1 Materials

Use only equipment and materials recommended by the splice manufacturer including calibrated cutting equipment to ensure consistent cut depths when preparing cable ends for the application of the splice kit. Use the cable manufacturer's recommended splice kit. Alternatively, if a kit is not available, connect the cable concentric neutral/shield wires across one side of the splice by split bundling the splice neutral wiring and connecting each bundle set to a continuous No. 4 AWG solid bare copper conductor via two compression conductors. Ensure the No. 4 AWG conductor extrudes from the cable splice jacket and connects to the manholes grounding system. Make all connections within the splice utilizing long barrel-type compression connectors and appropriate compression tools with proper size dies to ensure a satisfactory mechanical and electrical joint. Ensure bare connections of concentric neutral/shield wires are either contained within the splice kit or sealed via an additional outer covering, consisting of a heavy wall, heat-shrinkable tubing containing adhesive material (mastic) that melts as heat is applied and the outer tubing shrinks to form a moisture proof environmental seal. Provide outer tubing conforming to ANSI C119.1. Ensure splice meets the requirements of IEEE 404 matching the voltage rating of the cable, and is rated by the manufacturer for use on the same voltage rating as the cable. Take extra precautions to seal around the exit area of the bare copper jumpers with an additional mastic per the splice manufacturer's recommendations.

3.1.5.2 Splice Support

Firmly support cable splices made up in manholes on cable racks as indicated. Do not pull cable splices in ducts. Overlap cable ends at the ends of a section to provide sufficient undamaged cable for splicing. Overlap cables to be spliced in manholes to the centerline of the proposed joint by not less than 2 feet.

Locate cable splices in manholes midway between the cable racks on the walls of the manholes and supported with cable arms at approximately the same elevation as the enclosing duct. Support each cable end termination using a pair of saddle supports under the cable end termination or cable with a minimum 12 inches and a maximum 30 inches separation between the supports. Secure the cable end termination and cable to the supports in a manner that prevents movement of termination or cable at the support. Install saddle supports on a galvanized steel framing channel that is anchored to the wall, securely fastened to the cable tray, or installed by other approved methods.

3.1.6 Terminations

Terminate cables in approved cable termination kits. Provide terminations with adequate means for making external connections to the cable conductors of single-conductor cables (phase and concentric neutral if applicable), as well as the single cables of multi-conductor cables. Protect the cable insulation against moisture, oil, or other contaminants. Take extra precautions in physically protecting and supporting cables, and maintaining the insulation level of the cable.

3.1.7 Cable Identification

Provide identification of all cables on both ends using the designations shown on the Contract drawings or as otherwise shown on approved shop drawings. Display the designation by tags conforming to Paragraph 2.5.2

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Cable Tags. Install markers in uniform positions on the cables, and where the legends are visible where conductors are terminated at the equipment. Fasten the tags or band markers at each termination, junction or pull box, where cables enter or leave cable trays, manholes, and at other points of access. Install cable tags over the fireproofing as needed. Position the tags so that they are clearly visible without disturbing any cabling or wiring.

3.1.8 Fireproofing

Provide fireproofing (Arc Proofing) for individual cable conductor in manholes, handholes and vaults which carry current at 2200 volts or more. Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Extend the tape 1 inch into the ducts. To prevent unraveling, random wrap the fireproofing tape the entire length of the fireproofing with pressure-sensitive glass cloth tape.

3.1.9 Grounding

Include a separate ground conductor in all circuits unless the drawings indicate equipment grounding at both ends to the embedded grounding grid of the facility if available, or unless the ground conductor is an integral part of a multiple conductor cable. Support exposed ground cable runs to follow conduit, equipment or concrete wall contours using corrosion resistant clamps or clips. Drilling of equipment housings or frames will be permitted only when approved. Use concrete anchors for fastening to concrete surfaces.

3.2 DEMOLITION OR CABLE CUTTING

Notify the Contracting Officer 14 working days prior to an outage for demolition or cable cutting of medium voltage electrical system. The Government has established a mandatory inspection point prior to Contractor performing any medium voltage cable cuts or demolition. Notify the Contracting Officer 48 hours in advance of this mandatory inspection point.

As part of the mandatory inspection point, positively identify and label the medium voltage cable to be worked utilizing an electronic cable identifier. Ensure the process of identifying and labeling the cable to be worked is witnessed by the Government. Cable cutting and demolition of any medium voltage cable can occur only after approval by the Contracting Officer. Cut medium voltage cables and conductors by indirect means using cable cutters specifically designed to be operated remotely only. Cutting of medium voltage cables and conductors by direct means is not permitted.

3.3 FIELD ACCEPTANCE TESTING

3.3.1 Testing

Test per IEEE 400 and NETA ATS recommended procedures.

- a. Submit Test Reports in accordance with referenced standards in this section.
- b. After completion of the installation and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- c. Provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.
- d. Perform all Field Acceptance Testing and submittals as described herein.
- e. Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Use substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices to isolate the circuits under test.
- f. Retain suitable and complete records indicating the insulation-resistance tests, high voltage tests, continuity tests, phase rotation tests, high potential tests, and conductor identification markings. Provide a duplicate record of all tests to the Contracting Officer. Prior to testing, submit the wire and cable test record form for approval. Provide room for the Contracting Officer's signature on the test report.

3.3.2 Tests to be Performed

After installation, but just prior to terminal connection, perform as a minimum the following tests:

- a. Perform a Conductor Continuity Test on each wire and each individual conductor of a multiconductor cable to insure correct connections end-to-end.
- b. Perform a Shield Continuity Test on each cable shield.
- c. Perform a Shield Resistance Test on each cable shield. Shield resistance must be less than 10 ohms per 1000 feet of cable.
- d. Perform an Insulation Resistance Test on each field-installed conductor with respect to ground and adjacent conductors in a cable assembly. Perform applied potential test at 2500 volts DC for 5kV and 15kV rated cable. Minimum insulation resistance values must not be less than 1500 Megohms for 5kV rated cable, and 5000 Megohms for 15kV rated cable.
- e. Perform a VLF AC High Potential Test on each shielded cable in accordance with IEEE 400.2. Test each field-installed conductor with respect to ground and adjacent conductors. If the Contractor believes that VLF AC testing is not feasible or not recommended for any given situation, the Contractor may instead perform DC testing with the explicit approval of both the cable manufacturer and the Contracting Officer on an individual case basis. If approved, perform the DC test at the voltage recommended by the cable manufacturer. In lieu of the cable manufacturer's recommendation for a voltage level, perform the test in accordance with NETA ATS Table 100.6.1.
- f. Perform a Phase Rotation Test on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment to verify matching the phasing at connections to new or existing equipment, and to existing systems.
- g. Tests must be witnessed by the Contracting Officer, and the wire

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

and cable installation test reports submitted in accordance with
Section 01 33 00, SUBMITTAL PROCEDURES.

3.3.3 Acceptance

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductors until the final test reports are reviewed and approved by the Contracting Officer.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 26 05 48

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT **11/23**

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.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16 (2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.21.1 (2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

ASME B18.22M (1981; R 2017) Metric Plain Washers

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

ASTM A53/A53M (2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A153/A153M (2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A307 (2023) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

ASTM A500/A500M (2023) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A563 (2021; E 2022a) Standard Specification for Carbon and Alloy Steel Nuts

ASTM A572/A572M (2021; E 2021) Standard Specification for

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

High-Strength Low-Alloy Columbium-Vanadium Structural Steel

ASTM A603	(2019) Standard Specification for Zinc-Coated Steel Structural Wire Rope
ASTM A992/A992M	(2022) Standard Specification for Structural Steel Shapes
ASTM E580/E580M	(2024a) Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions
ASTM F436	(2011) Hardened Steel Washers
ASTM F959/F959M	(2017a; R 2023) Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC ES AC156	(2012) Acceptable Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components
--------------	---

METAL FRAMING MANUFACTURERS ASSOCIATION (MFMA)

MFMA-4	(2004) Metal Framing Standards Publication
--------	--

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-810	(2022; Rev H; Change 1) Environmental Engineering Considerations and Laboratory Tests
UFC 3-301-01	(2023; with Change 3, 2025) Structural Engineering
UFC 3-301-02	(2023; with Change 1, 2025) Design of Risk Category V Structures, National Strategic Military Assets

UL SOLUTIONS (UL)

UL 1598	(2021; Reprint Jan 2024) UL Standard for Safety Luminaires
---------	---

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION
(VISCMA)

VISCMA 413

(2014) Installing Seismic Restraints for
Electrical Equipment

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Design and provide seismic supports and attachments in accordance with UFC 3-301-01 and ASCE 7-16. Design and provide seismic supports and attachments, and isolation and energy dissipation systems in accordance with UFC 3-301-02.

Components, supports, and attachments must comply with following structural design criteria:

Risk Category: II.

Seismic Design Category: D.

Seismic Design Spectral Response Acceleration Parameter at Short Period (SDS): 0.124.

Seismic Design Spectral Response Acceleration Parameter at period of 1 second (SD1): 0.094.

Seismic relative displacement within structure.

Apply the seismic requirements described in this section and on the drawings to the electrical components listed in paragraph ELECTRICAL COMPONENTS.

Electrical components and their supports must be attached or anchored to structure.

1.2.2 Electrical Components

Provide seismic supports and attachments for the following electrical components in accordance with the requirements of this specification:

Components with Importance Factor (I_p) = 1.0:

Battery Systems

Control Panels

Light Fixtures

Motors

Distribution Systems Conduit and Raceway

Components with Importance Factor (I_p) = 1.5 Designated Seismic Systems

Fire detection and suppression systems

Emergency exit lighting

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.2.3 Contractor Designed Supports and Attachments

Provide seismic supports and attachments for electrical components.

Contractor must retain services of a Registered Professional Engineer to design supports and attachments, and isolation and energy dissipation systems for electrical components. Supports and attachments, and isolation and energy dissipation systems that induce torsion in structural members are not permitted.

Submit copies of the Design Calculations and Design Drawings. Calculations and Drawings must be stamped and signed by Contractor's Registered Professional Engineer.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Equipment Requirements;

Lighting Fixtures;

SD-03 Product Data

Supports and Attachments;

Equipment Requirements;

Lighting Fixtures;

Flexible Fittings;

Anchors;

Isolation And Energy Dissipation Systems;

SD-05 Design Data

Design Calculations;

Design Drawings;

Independent Design Review Report;

SD-06 Test Reports

Anchors;

SD-07 Certificates

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

ICC ES AC156 Shake Table Test;

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

Equipment must be rugged enough to survive design seismic event.

Submit detail drawings of supports and attachments, and isolation and energy dissipation systems along with calculations, catalog cuts, templates, and erection and installation details, as appropriate, for the items listed in paragraph ELECTRICAL COMPONENTS. Indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction.

Submit calculations and drawings that are stamped and signed by Contractor's registered professional engineer. Design must be based on actual equipment and system layout. Design must include calculated loads and capacity of materials utilized for the connection of the equipment or system to the structure. Analysis must detail anchoring methods. Include drawing for Designated Seismic System Equipment indicating the equipment location in the facility to be used for the installation. Equipment must be rigidly or flexibly mounted as indicated. Roof mounted equipment both vibration isolated and nonisolated, must have support members designed and anchored to building structure.

2.1.1 Rigidly (Base and Suspended) Mounted Equipment

Equipment furnished under this Contract must be rigidly mounted. For any rigid equipment which is rigidly anchored, provide flexible joints for electrical conduit, cabletray, busway, and raceway, that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions. Designated Seismic Systems (DSS) for RC IV buildings assigned to Seismic Design Category (SDC) C, D, E, or F and Risk Category IV components needed for continued operation after an earthquake must have two nuts provided on each bolt.

2.1.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment must be constructed and assembled to resist seismic loads and meet associated seismic criteria.

Nonrigid or Flexibly-Mounted:

2.1.3 Premanufactured Modular Electrical Systems

The following specific items of equipment must be manufactured, constructed, and assembled to resist seismic loads and meet associated seismic criteria.

Premanufactured modular electrical systems:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2 LIGHTING FIXTURES

Provide lighting fixtures and supports and attachments conforming to UL 1598.

2.3 SUPPORTS AND ATTACHMENTS

Material used for members listed in this section, must conform with the following:

- a. Plates, rods, and rolled shapes, ASTM A36/A36M, ASTM A572/A572M Grade 50, or ASTM A992/A992M.
- b. Wire rope, ASTM A603 pre-stretched, with Class B weight zinc-coated wires throughout rope. Connect rope at ends using ferrule or saddle-type wire rope clamp systems. Ferrule clamps must be qualified by testing for use in seismic applications per VISCMA 413. Saddle-type clamps must be used with minimum of two clamps at each end of wire rope.
- c. Tubes, ASTM A500/A500M, Grade B.
- d. Pipes, ASTM A53/A53M, Grade B.
- e. Angles, ASTM A36/A36M.
- f. Channels (Struts) with in-turned lips and associated hardware for fastening to channels at discrete points conforming to MFMA-4.
- g. Fasteners:
 - (1) High-strength bolts, ASTM F3125/F3125M, Grade A325, heavy hex.
 - (2) Nuts, ASTM A563. Use heavy hex nuts for high strength bolts and anchor bolts.
 - (3) Washers, ASME B18.22M and ASME B18.21.1, except use ASTM F436 washers for high strength bolts.
 - (4) Galvanized coating, ASTM A153/A153M.
 - (5) Direct Tension Indicator Washers, ASTM F959/F959M. Submit product data for direct tension indicator washers.
 - (6) Standard bolts, ASTM A307.
- h. Anchor bolts:
 - (1) Cast in anchors: Refer to Section 05 12 00 STRUCTURAL STEEL 05 50 13 MISCELLANEOUS METAL FABRICATIONS for requirements.
 - (2) Post-installed anchors: Refer to Section 05 05 20 POST-INSTALLED CONCRETE AND MASONRY ANCHORS for requirements.
- i. Welding: Refer to Section 05 12 00 STRUCTURAL STEEL Section 05 50 14 STRUCTURAL METAL FABRICATIONS for requirements.

2.4 FLEXIBLE FITTINGS

Provide flexible fittings to allow conduit, cabletray, busway, and raceway

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

systems to accommodate seismic movement between equipment and conduit, cabletray, busway, and raceway systems and supporting structure. Use specification grade steel fittings conforming to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMMIL-STD-810. Provide suitable watertight expansion fittings that maintain electrical continuity by bonding jumper or other means. Flexible fittings must accommodate minimum of 4 inches seismic movement in each orthogonal directions.

PART 3 EXECUTION

3.1 SUPPORTS AND ATTACHMENTS

Provide supports and attachments with continuous load path to distribute electrical component seismic loads to structure.

Provide supports and attachments for electrical components that conform to UFC 3-301-01 requirements. Install vertical diagonal braces at a 45-degree slope. Where interference is present, the slope may be minimum of 30 degrees or a maximum of 60 degrees per VISCMA 413.

Provide bolted and welded connections for supports and attachments in accordance with UFC 3-301-01.

Provide welding in accordance with AWS D1.1/D1.1M. Grind visible welds smooth in the finished installation.

3.2 BUILDING DRIFT

Do not attach electrical components to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided. Electrical components, supports, and attachments must be capable of accommodating building story drifts, deflections, and relative displacements.

3.3 CONDUIT, CABLETRAY, BUSWAY, AND RACEWAY

Provide supports and attachments for conduit, cabletray, busway, and raceway conforming to the requirements of UFC 3-301-01.

3.4 LIGHTING FIXTURES

Provide lighting fixtures and supports conforming to the following:

3.4.1 Pendant Fixtures

Provide pendant fixtures conforming to the requirements of UFC 3-301-01.

3.4.2 Ceiling Attached Fixtures

3.4.2.1 Recessed Fixtures

Support recessed individual or continuous-row mounted fixtures by a seismic-resistant suspended ceiling support system built in accordance with ASTM E580/E580M. Provide supports and attachments for the fixtures conforming to the requirements of UFC 3-301-01. Recessed lighting fixtures not over 56 pounds in weight and not required to be supported separately from the structure, may be supported by and attached directly to the ceiling system runners using screws or bolts, number and size as required by the seismic design. Provide lock or screw attachments for

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

fixture accessories, including diffusers and lenses.

3.4.2.2 Surface-Mounted Fixtures

Attach surface-mounted individual or continuous-row fixtures to a seismic-resistant ceiling support system built in accordance with ASTM E580/E580M Section 09 51 00 ACOUSTICAL CEILINGS. Provide supports and attachments for the fixtures conforming to the requirements of UFC 3-301-01.

3.4.3 Assembly Mounted on Outlet Box

Design a supporting assembly, that is intended to be mounted on an outlet box, to accommodate mounting features on 4 inch boxes, plaster rings, and fixture studs.

3.4.4 Wall-Mounted Emergency Light Unit

Design and secure attachments for wall-mounted emergency light units for the worst expected seismic disturbance at the site.

3.5 ANCHORS

3.5.1 General

Submit copies of test results to verify the adequacy of the specific anchor and application, as specified. Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices allowing adequate edge distance and embedment depth for restraint anchor bolts. Identify position of reinforcing steel and other embedded items prior to drilling holes for post-installed anchors. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Fill annular gap with nonshrink grout at equipment anchor bolts where clearance between anchor and equipment support hole exceeds 0.125 inches.

3.5.2 Cast-In-Place Anchors

Use templates to locate cast-in-place bolts accurately and securely in formwork. Provide anchor bolts with an embedded straight length with heavy hex nut and plate washer as to provide required strength and ductility. Anchor bolts that exceed the normal depth of equipment foundation piers or pads must either extend into concrete floor or the foundation or increase depth of the piers or pads to accommodate bolt lengths.

3.5.3 Post-Installed Anchors

Refer to Section 05 05 20 POST-INSTALLED CONCRETE AND MASONRY ANCHORS for requirements.

3.6 EQUIPMENT SUPPORT REQUIREMENTS

3.6.1 Suspended Equipment

Provide supports and attachments for components supported from structural systems. Provide supports and attachments that consist of angles, rods, wire rope, bars, channels (struts) or pipes arranged as shown in bracing submittals and secured at both ends with not less than 1/2 inch bolts. Provide sufficient supports and attachments to resist seismic forces as

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

specified in UFC 3-301-01 without exceeding capacity of structural components. Provide, for approval, specific force calculations in accordance with UFC 3-301-01 for the project.

Submit details of supports and attachments for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight when hangers are inclined. Where interference is present, the inclined hanger slope may be minimum of 30 degrees or a maximum of 60 degrees per VISCMA 413.

3.6.2 Floor or Pad Mounted Equipment

3.6.2.1 Shear Resistance

Bolt components to floor or pads. Provide bolts to resist seismic forces in accordance with paragraph ANCHORS.

3.6.2.2 Overturning Resistance

Use the ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads to determine if overturning forces need to be considered in the sizing of anchor bolts. Provide calculations to verify the adequacy of the anchor bolts for combined shear and tension. Provide bolts to resist seismic forces in accordance with paragraph ANCHORS.

3.7 SPECIAL TESTING FOR SEISMIC-RESISTING COMPONENTS

Electrical components designated as Designated Seismic Systems required to remain operational after an earthquake must be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing agency for the specific components. Prequalified certifications are acceptable unless noted otherwise.

Components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material.

Provide component identification nameplates in accordance with UFC 3-301-01.

Mechanically attach nameplates to electrical components.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 26 05 73

POWER SYSTEM STUDIES

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 1584	(2018; E 2019) Guide for Performing Arc-Flash Hazard Calculations
IEEE 1584.1	(2022) Guide for the Specification of Scope and Deliverable Requirements for an Arc-Flash Hazard Calculation Study
IEEE 3002.2	(2018) Recommended Practice for Conducting Load-Flow Studies and Analysis of Industrial and Commercial Power Systems
IEEE 3002.3	(2018) Recommended Practice for Conducting Short-Circuit Studies and Analysis of Industrial and Commercial Power Systems
IEEE C2	(2023) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70E	(2024) Standard for Electrical Safety in the Workplace
----------	--

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-560-01	(2017; with Change 3, 2023) Operation and Maintenance: Electrical Safety
--------------	--

1.2 SYSTEM DESCRIPTION

The power system covered by this specification consists of: All new electrical equipment..

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Field Examination Plan;
Arc Flash Label Formats;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SD-06 Test Reports

Field Examination

SD-07 Certificates

System Analyzer;

SD-11 Closeout Submittals

Model Files;

Load Flow Study;

Fault Current Study;

System Coordination Study;

Arc Flash Hazard Study;

1.4 QUALITY ASSURANCE

1.4.1 System Analyzer

The System Analyzer must perform the power system studies. The System Analyzer must be a registered professional electrical engineer with a minimum of 3 years of experience with power system studies. Include a list of three comparable jobs performed by the System Analyzer with specific names and telephone numbers for reference. Include the license number and state of the registered Professional Engineer.

1.4.2 System Verifier

The System Verifier may inspect and record settings, markings, and otherwise document the existing equipment. The System Verifier may also place appropriate hazard labels on equipment. The System Verifier must not make any calibrations or adjustments or place equipment into service. When working with energized equipment, the system verifier must be a Qualified Person per NFPA 70E or working under the direct supervision of a Qualified Person. The System Verifier may communicate with the system owner to determine if the equipment within the studied system has received maintenance and testing in accordance with NETA MTS or NFPA 70B.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 FIELD EXAMINATION

For each pre- and post-study inspection, submit a field examination plan identifying which facilities must be examined to complete the required work. Include a complete information verification procedure, where Qualified Personnel will be required, PPE requirements for "live" equipment examinations, and equipment to be used within the limited approach boundary of the equipment.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.1 General

Perform field inspections of the site and equipment before the first study and after the last study to determine the state and settings of the equipment and to verify the final settings agree with the studies. Perform the post-study inspection(s) after changing settings, after performing acceptance tests, and before placing equipment in service.

Schedule the field examination by the System Verifier with the Contracting Officer at least 10 business days before conducting examination. Furnish all materials, labor, and equipment necessary to conduct the examination. Maintain a written record of the all equipment examined, equipment location, equipment ratings, settings, personnel involved, and the date the examination was performed. Submit the written record of each field examination.

3.1.2 Safety

Where examination of the equipment requires energized equipment to be opened, provide a Qualified Person to directly supervising any non-Qualified Person within the hazard area. Use PPE, protective barriers, danger signs and other safety devices to protect and warn personnel in the vicinity of "live" equipment being examined.

3.1.3 Application of Arc Flash Labels

Install arc flash warning labels using Qualified Personnel as necessary after the setting and inspection is complete. For new or modified equipment, install labels before the equipment is energized for the first time after installation/modification or setting changes. Schedule the label placement with the Contracting Officer at least 5 business days before label placement. Furnish all materials, labor, and equipment necessary to place the labels. Maintain a written record of the all equipment that received labels, personnel involved, and the date labels were placed.

3.2 POWER SYSTEM STUDIES

Perform power system studies to demonstrate that the equipment selected and system constructed meet the contract requirements for fault current and interrupt ratings, coordination, protection, and Arc Flash Hazard. Submit reports of the studies along with protective device equipment submittals. Apply Arc Flash Hazard labels to equipment after the studies are approved. Update and resubmit the studies after any changes to the equipment or systems which may affect the study results, and re-apply Arc Flash Hazard labels to equipment after the resubmitted studies are approved. The Government is not responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices or labels ordered and/or procured before approval of the study.

Perform power system studies to demonstrate the system operation with regard to ratings, coordination, protection, and Arc Flash Hazard.

3.2.1 Scope of Studies

The scope of the studies must begin at the utility service entrance of a

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

building and extend down to load buses/panels where the fault current is 2,000 amperes or less (symmetrical) for distribution buses nominally operating at 208 volt AC and above.

The "source bus" is the source of energy for system being analyzed. This may be the energy feed from a utility, the first bus upstream of the work, generators within the work or upstream of the work, or any other source capable of contributing significant energy into the system being analyzed.

In the systems model for the studies, incorporate all existing and new equipment within the scope of the studies. Incorporate any additional sources or load equipment necessary to accurately model the system's performance.

3.2.2 Determination of Facts

Determine and document the time-current characteristics, features, ratings, ampacities, and nameplate data for each existing protective device, electrical equipment, and feeder cables. Obtain the available fault current from the owner of the source bus.

Utilize field-verified data in the power system studies. Document the field-verified data in the report.

3.2.3 Single Line Diagram

Provide a single line diagram showing the electrical system buses, devices, transformation points, and all sources of load current and fault current, including generator and motor contributions. Provide a diagram from the system model. Each bus, device or transformation point must have a unique identifier. Show the location of switches, breakers, and circuit interrupting devices on the diagram together with available fault data, and the device interrupting rating.

The naming of existing components within the system model and single line diagram must match existing installed equipment names. The naming of new components within the system model and single line diagram must use unique identifiers and be coordinated with the Government.

3.2.4 Load Flow Study

Perform the load flow study in accordance with IEEE 3002.2 to identify initial steady-state conditions for the fault current study. For each operating scenario, provide load flow results on the diagram or in the report. Show or describe the loading factors and assumptions used in each operating mode.

3.2.5 Fault Current Study

Use the results of the load flow study to perform the fault current study in accordance with IEEE 3002.3. Provide balanced three-phase fault, bolted line-to-line fault, and single line-to-ground fault current values at each voltage transformation point and at each power distribution bus. For each location, show in tabular form on the diagram or in the report the maximum and minimum available fault currents of all modes of operation for that location.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Where the available fault current at the source bus is not available, describe how the fault contribution from the source bus was determined and why this method is reasonable for the study.

3.2.6 System Coordination Study

Use the results of the load flow study and fault current study. For normal modes of operation, demonstrate that selectivity has been obtained between the devices within the scope of the project. Demonstrate the equipment, machines, and conductors are protected from damage from overloads and fault conditions. Include a description of the coordination of the protective devices in this project. Provide a written narrative describing which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations; coordination between upstream and downstream devices; and relay settings. Provide recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost damages (addition or reduction). Provide composite coordination plots on a log-log scale. Where recommendations are provided to improve or enhance system reliability, provide separate coordination plots on log-log scale showing the system coordination before and after the implementation of the recommendations. Where coordination has been adjusted to lower arc flash values, include a discussion of the change and the impact on the system within the report.

3.2.7 Arc Flash Hazard Study

Perform the arc flash hazard study in accordance with IEEE 1584.1. Utilize the data from the fault current study to determine the worst case incident energy per IEEE 1584, IEEE C2, and OSHA 29 CFR 1910.269 Appendix E. Use identified modes of operation to determine the worst case arc flash energy. If not included in another study, include a description of the devices and device settings for the operating modes that provided the highest arc flash energy. The use of a "maintenance switch" to temporarily reduce the Arc Flash incident energy for maintenance work is acceptable. Where the adjusting the coordination of devices to obtain lower arc flash values, include a discussion of the change and the impact on the system within the report. Where the arc flash energies exceed 1.2 cal/cm² provide recommendations to reduce the arc flash energy to 1.2 cal/cm².

3.2.8 Study report(s)

- a. Include a narrative describing the studies performed; the bases and methods used; and the desired method of coordinated protection of the power system.
- b. Include descriptive and technical data for existing devices and new protective devices proposed. Include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices. For existing devices, included statements on the condition of the equipment based upon field inspections and owner's statements and reports.
- c. Document utility company data including system voltages, fault MVA,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers and settings; and existing power system data including time-current characteristic curves and protective device ratings and settings. Identify all assumptions about the protection devices, equipment, and system where data was not available.

- d. For each bus in the system, provide fully coordinated composite time-current characteristics (TCC) curves as required to ensure coordinated power system protection between protective devices and equipment. In a tabular format, provide existing and recommended ratings and settings of all protective devices.
- e. Provide an arc flash study report in accordance with IEEE 1584.1.
- f. Provide the calculations performed for the studies, including computer programs utilized. Provide the name of the software package, developer, and version number.

3.2.9 Arc Flash Labels

Provide arc flash warning labels on electrical equipment likely to require examination, servicing, or maintenance while energized. Typical types of equipment include pad-mounted transformers, switchgear, switchboards, panelboards, disconnect switches, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling occupancies. The arc flash label naming must match the naming used in the system modeling and the single line diagram.

Comply with the label requirements specified in UFC 3-560-01. Obtain approval of arc flash label formats before printing.

- a. Provide a 3.5 inch x 5 inch to 4 inch x 6 inch thermal transfer type label of high adhesion polyester for each location device analyzed. The label must remain in place and be legible for at least 5 years in the installed environment.
- b. Labels must be machine printed with no field markings. Provide arc flash labels in the following manner. All labels must be based on implemented overcurrent devices and settings.
 1. Provide at least one arc flash label for each 480 volt and 208 volt panelboards.
 2. Provide at least one arc flash label for each low voltage (less than 1000 V) switchboard.
 3. Where the equipment construction has different hazards levels in different areas, provide a label for each compartment, cubicle, or section separated by barriers.
- c. Use the worst case hazard of all operating scenarios unless mitigation procedures are used. If mitigation procedures are used, explain the procedures on the label.

3.3 MODELING

Develop a software model of the electrical system identified in the scope of the studies. Use the latest version of SKM PowerTools(TM) or

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

EasyPower(TM). Develop the model with accurate, verified information. Model existing electrical equipment, machines, devices, and conductors directly connected to, altered by, or otherwise affected by the work. This includes, but is not limited to generators, transformers, switchgear, switchboards, panelboards, motor control centers, motors, voltage regulators, tap changers, protective relays, circuit breakers, switches, fuses, conductors, capacitors, reactors, grounding system, and control equipment.

Provide the final model files in their native editable formats for future use by the Government. Include device information for devices not in the software vendor's standard distribution.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING

11/22

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.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
----------	--

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM applies to this section with additions and modifications specified herein.

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 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-06 Test Reports

Acceptance Tests and Inspections;

SD-07 Certificates

Qualifications of Organization, and Lead Engineering Technician;

Acceptance Test and Inspections Procedure;

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph ACCEPTANCE TESTS AND INSPECTIONS herein. Organization must be independent of the supplier, manufacturer, and installer of the equipment. The organization must be a first tier subcontractor. No work required by this section of the specification may be performed by a second tier subcontractor.

- a. Submit name and qualifications of organization. Organization must have been regularly engaged in the testing of electrical materials,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

devices, installations, and systems for a minimum of 5 years. The organization must have a calibration program, and test instruments used must be calibrated in accordance with NETA ATS.

- b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments must be performed by an engineering technician, certified by NETA (Level III) or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization will perform acceptance tests and inspections. Test methods, procedures, and test values must be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph FIELD QUALITY CONTROL of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Place equipment in service only after completion of required tests and evaluation of the test results have been completed. Supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Notify Contracting Officer at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

- a. Section 26 12 19 PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS
- b. Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

f. 3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization must be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 26 12 19

PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS 05/24

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 CONCRETE INSTITUTE (ACI)

ACI 318 (2019; R 2022) Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1 (2014; Errata 2016) Electric Meters - Code for Electricity Metering

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M (2025a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM D92 (2012a) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

ASTM D97 (2017b) Standard Test Method for Pour Point of Petroleum Products

ASTM D877/D877M (2019) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

ASTM D1535 (2014; R 2018) Standard Practice for Specifying Color by the Munsell System

FM GLOBAL (FM)

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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386 (2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV

IEEE C2 (2023) National Electrical Safety Code

IEEE C37.47 (2011) Standard for High Voltage

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Distribution Class Current-Limiting Type Fuses and Fuse Disconnecting Switches

IEEE C57.12.00	(2021) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.28	(2023) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.34	(2022) Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 10 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below
IEEE C57.12.80	(2010) Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	(2021) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.98	(2011) Guide for Transformer Impulse Tests
IEEE C62.11	(2020) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
----------	--

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 260	(1996; R 2004) Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas
NEMA Z535.4	(2023) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 1 2024; TIA 24-1; TIA 25-2) National Electrical Code
---------	--

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1992) Fish Acute Toxicity Test
---------------	---------------------------------

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 712-C-98-075	(1998) Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"
EPA 821-R-02-012	(2002) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 431	Energy Efficiency Program for Certain Commercial and Industrial Equipment
------------	--

UL SOLUTIONS (UL)

UL 467	(2022) UL Standard for Safety Grounding and Bonding Equipment
--------	--

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 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.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are 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

Pad-mounted Transformer Drawings;

SD-03 Product Data

Pad-mounted Transformers;

SD-06 Test Reports

Acceptance Checks and Tests;

SD-07 Certificates

Transformer Efficiencies;

SD-09 Manufacturer's Field Reports

Transformer Test Schedule;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Pad-mounted Transformer Design Tests;

Pad-mounted Transformer Routine and Other Tests;

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5;

1.4.1 Reduced Submittal Requirements

Transformers designed and manufactured by ABB/Hitachi Energy in Jefferson City, MO; by Eaton's Cooper Power Series Transformers in Waukesha, WI; by ERMCO in Dyersburg, TN; or by Howard Industries in Laurel, MS need not submit the entire submittal package requirements of this contract. Instead, submit the following items:

- a. A certification, signed by the manufacturer, stating that the manufacturer will meet the technical requirements of this specification.
- b. An outline drawing of the transformer with devices identified (paragraph PAD-MOUNTED TRANSFORMER DRAWINGS, item a).
- c. ANSI nameplate data of the transformer (paragraph PAD-MOUNTED TRANSFORMER DRAWINGS, item b).
- d. Provide transformer test schedule and routine and other tests required by submittal item "SD-09 Manufacturer's Field Reports".
- e. Provide acceptance test reports required by submittal item "SD-06 Test Reports".
- f. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

1.5 QUALITY ASSURANCE

1.5.1 Pad-Mounted Transformer Drawings

Include the following as a minimum:

- a. An outline drawing, including front, top, and side views.
- b. IEEE nameplate data.
- c. Elementary diagrams and wiring diagrams with terminals identified of watt-hour meter and current transformers.
- d. One-line diagram, including switch(es), current transformers, meters, and fuses.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, except of NFPA 70 when more stringent requirements are specified or indicated, 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,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

materials, installation, and workmanship in accordance with NFPA 70 unless more stringent requirements are specified or indicated.

1.5.3 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.

1.5.3.1 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.

1.5.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.6 MAINTENANCE

1.6.1 Additions to Operation and Maintenance Data

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

- a. An instruction manual with pertinent items and information highlighted
- b. An outline drawing, front, top, and side views
- c. Prices for spare parts and supply list
- d. Routine and field acceptance test reports
- e. Fuse curves for primary fuses
- f. Information on watthour demand meter, CT's, and fuse block
- g. Actual nameplate diagram
- h. Date of purchase

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION, Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM,.

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.28 and as specified herein. Submit manufacturer's information for each component, device, insulating fluid, and accessory provided with the transformer.

2.2.1 Compartments

Provide high- and low-voltage compartments separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment contains: the incoming line, insulated high-voltage load-break connectors, bushing well inserts, six high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to oil-immersed bayonet fuses, dead-front surge arresters, tap changer handle, connector parking stands with insulated standoff bushings, protective caps, and ground pad.

Minimum high-voltage compartment dimensions: IEEE C57.12.34, Figures 16 and 17.

a. Insulated high-voltage load-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector must have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well inserts: IEEE 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.

c. One-piece bushings: IEEE 386, 200 amperes, 15 kV Class.

d. Load-break switch

Radial-feed two-position oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 12,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

e. Provide bayonet oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. The bayonet fuse links sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. Include an oil retention valve inside the bayonet assembly housing, which closes when the fuse holder is removed, and an external drip shield to minimize oil spills. Display a warning label adjacent to the bayonet fuse(s) cautioning against removing or inserting fuses unless the transformer has been de-energized and the tank pressure has been released.

Bayonet fuse assembly: 150 kV BIL.

Oil-immersed current-limiting fuses: IEEE C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified. Connect current-limiting fuses ahead of the radial-feed load-break switch.

- f. Surge arresters: IEEE C62.11, rated 15 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap. Provide three arresters for radial feed circuits.
- g. Parking stands: Provide a parking stand near each bushing. Provide insulated standoff bushings for parking of energized high-voltage connectors on parking stands.
- h. Protective caps: IEEE 386, 200 amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushings.

2.2.1.2 Low Voltage

Low-voltage compartment contains: low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

- a. Include the following accessories: drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

2.2.2 Transformer

- a. Less-flammable bio-based liquid-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.
- b. Transformer rated 750 kVA & 500 kVA refer to drawings.
- c. Transformer voltage ratings 750 kVA: 13,200 V Delta - 480 V GrdY.
- d. Transformer voltage ratings 500 kVA: 13,200 V Delta - 208 V GrdY
- e. Tap changer: externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Indicate which tap setting is in use, clearly visible when the compartment is opened.
- f. Minimum tested percent impedance at 85 degrees C:
 - (1) .50 for units rated 75kVA and below
 - (2) .87 for units rated 112.5kVA to 300kVA

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- (3) .03 for 500kVA rated units
- (4) .32 for units rated 750kVA and above

g. Comply with the following audible sound level limits:

KVA	DECIBELS (MAX)
75	51
112.5	55
150	55
225	55
300	55
500	56
750	57
1000	58
1500	60
2000	61
2500	62

h. Include:

- (1) Lifting lugs and provisions for jacking under base, with base construction suitable for using rollers or skidding in any direction.
- (2) An insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.
- (3) Provide transformer top with an access handhole.
- (4) kVA rating conspicuously displayed on its enclosure.

2.2.2.1 Specified Transformer Efficiencies

Provide transformer efficiency calculations utilizing the actual no-load and load loss values obtained during the routine tests performed on the actual transformer(s) prepared for this project. Reference no-load losses (NLL) at 20 degrees C. Reference load losses (LL) at 55 degrees C and at 50 percent of the nameplate load. The transformer is not acceptable if the calculated transformer efficiency is less than the efficiency indicated in the "KVA / Efficiency" table below. The table is based on requirements contained within 10 CFR 431, Subpart K. Submit certification, including supporting calculations, from the manufacturer indicating conformance.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

<u>KVA</u>	<u>EFFICIENCY (percent)</u>
15	98.65
30	98.83
45	98.92
75	99.03
112.5	99.11
150	99.16
225	99.23
300	99.27
500	99.35
750	99.40
1000	99.43
1500	99.48
2000	99.51
2500	99.53
above 2500	99.54

2.2.3 Insulating Liquid

- a. Less-flammable transformer liquids: NFPA 70 and FM APP GUIDE for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D92 and a dielectric strength not less than 33 kV tested per ASTM D877/D877M. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

Provide a fluid that is a biodegradable, electrical insulating, and cooling liquid classified by UL and approved by FM as "less flammable" with the following properties:

- (1) Pour point: ASTM D97, less than -15 degree C
- (2) Aquatic biodegradation: EPA 712-C-98-075, ultimately biodegradable as designated by EPA.
- (3) Trout toxicity: OECD Test 203, zero mortality of EPA 821-R-02-012, pass

2.2.3.1 Liquid-Filled Transformer Nameplates

Provide nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.4 Corrosion Protection

Provide corrosion resistant bases and cabinets of transformers, fabricated of stainless steel conforming to ASTM A240/A240M, Type 304 or 304L. Base includes any part of pad-mounted transformer that is within 3 inches of concrete pad.

Paint entire transformer assembly Munsell 7GY3.29/1.5 green, with paint coating system complying with IEEE C57.12.28 regardless of base, cabinet, and tank material. The Munsell color notation is specified in ASTM D1535.

2.3 WARNING SIGNS AND LABELS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts in accordance with NEMA Z535.4 and NEMA 260.

- a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning labels on the outside of the high voltage compartment door(s) with nominal dimensions of 7 by 10 inches with the legend "WARNING HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. Include the word "WARNING" in white letters on an orange background and the words "HIGH VOLTAGE" in black letters on a white background.

2.4 ARC FLASH WARNING LABEL

Provide arc flash warning label for the enclosure of pad-mounted transformers. Locate this self-adhesive warning label on the outside of the high voltage compartment door warning of potential electrical arc flash hazards and appropriate PPE required. Provide label format as indicated.

2.5 GROUNDING AND BONDING

UL 467. Provide grounding and bonding as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.6 PADLOCKS

Provide padlocks for pad-mounted equipment, keyed as directed by the Contracting Officer. Comply with Section 08 71 00 DOOR HARDWARE.

2.7 CAST-IN-PLACE CONCRETE

Provide concrete associated with electrical work for other than encasement of underground ducts rated for 4000 psi minimum 28-day compressive strength unless specified otherwise. Conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.8 SOURCE QUALITY CONTROL

2.8.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

- (1) Provide a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
- (2) Accuracy: Traceable to the National Institute of Standards and Technology.
- (3) Instrument calibration frequency schedule: less than or equal to 12 months for both test floor instruments and leased specialty equipment.
- (4) Dated calibration labels: visible on all test equipment.
- (5) Calibrating standard: higher accuracy than that of the instrument tested.
- (6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:
 - (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
 - (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.8.2 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for each of the specified transformer(s), with design tests performed prior to the award of this contract.

- a. Tests: certified and signed by a registered professional engineer.
- b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (KNAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.
- c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests includes the primary windings only of that transformer.
 - (1) IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- (2) State test voltage levels.
- (3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.
- d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.34.
- e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.
- f. Short circuit: "Basically the same design" for the short circuit test means a pad-mounted transformer with the same kVA as the transformer specified.

2.8.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests: performed in accordance with IEEE C57.12.90 by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence as follows:

- a. Phase relation
- b. Ratio
- c. No-load losses (NLL) and excitation current
- d. Load losses (LL) and impedance voltage
- e. Dielectric
 - (1) Impulse
 - (2) Applied voltage
 - (3) Induced voltage
- f. Leak

PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 25 ohms.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide a ground ring around the transformer with 1/0 AWG bare copper. Provide four ground rods in the ground ring, one per corner. Install the ground rods at least 10 feet apart from each other. Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" applies.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Meters and Current Transformers

ANSI C12.1.

3.4 FIELD APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.5 NOT USED3.6 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab as follows:

- a. Unless otherwise indicated, provide the slab with dimensions at least 8 inches thick, reinforced with a 6 by 6 inches - W2.9 by W2.9 mesh placed uniformly 4 inches from the top of the slab.
- b. Place slab on a 6 inch thick, well-compacted gravel base.
- c. Install slab such that top of concrete slab is approximately 4 inches above the finished grade with gradual slope for drainage.
- d. Provide edges above grade with 1/2 inch chamfer.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- e. Provide slab of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.6.1 Cast-In-Place Concrete

Provide cast-in-place concrete work in accordance with the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE ACI 318.

3.6.2 Sealing

When the installation is complete, seal all entries into the equipment enclosure with an approved sealing method. Provide seals of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7 FIELD QUALITY CONTROL

3.7.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS. Submit reports, including acceptance criteria and limits for each test in accordance with NETA ATS "Test Values".

3.7.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.
- (3) Inspect anchorage, alignment, and grounding.
- (4) Verify the presence of PCB content labeling.
- (5) Verify the bushings and transformer interiors are clean.
- (6) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (7) Verify correct liquid level in tanks and bushings.
- (8) Verify that positive pressure is maintained on gas-blanketed transformers.
- (9) Perform specific inspections and mechanical tests as recommended by manufacturer.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- (10) Verify de-energized tap changer position is left as specified.
- (11) Verify the presence of transformer surge arresters.

b. Electrical tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.
- (2) Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.
- (3) Perform insulation-resistance tests, winding-to-winding and each winding-to-ground. Calculate polarization index. Verify that the tap changer is set at the specified ratio.
- (4) Perform turns-ratio tests at all tap positions.
- (5) Perform insulation power-factor or dissipation-factor tests on all windings in accordance with test equipment manufacturer's published data.
- (6) Perform power-factor or dissipation-factor tests on each bushing equipped with a power-factor/capacitance tap. In the absence of a power-factor/capacitance tap, perform hot-collar tests.
- (7) Measure the resistance of each high-voltage winding in each de-energized tap-changer position. Measure the resistance of each low-voltage winding in each de-energized tap-changer position, if applicable.
- (8) Remove and test a sample of insulating liquid for the following: Dielectric breakdown voltage, Acid neutralization number, Specific gravity, Interfacial tension, Color, Visual Condition, Water in insulating liquids (Required on 25 kV or higher voltages and on all silicone-filled units.), and Power factor or dissipation factor.
- (9) Perform dissolved-gas analysis (DGA) on a sample of insulating liquid.

3.7.1.2 Current Transformers

a. Visual and mechanical inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Verify correct connection.
- (4) Verify that adequate clearances exist between primary and secondary circuit wiring.
- (5) Verify the unit is clean.
- (6) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

- (7) Verify that all required grounding and shorting connections provide good contact.
- (8) Verify correct operation of transformer withdrawal mechanism and grounding operation.
- (9) Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

b. Electrical tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
- (2) Perform insulation-resistance test.
- (3) Perform a polarity test.
- (4) Perform a ratio-verification test.

3.7.1.3 Watthour Meter

a. Visual and mechanical inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Verify tightness of electrical connections.

b. Electrical tests

- (1) Calibrate watthour meters according to manufacturer's published data.
- (2) Verify that correct multiplier has been placed on face of meter, where applicable.
- (3) Verify that current transformer secondary circuits are intact.

3.7.1.4 Grounding System

a. Visual and mechanical inspection

- (1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

- (1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

- (2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.7.1.5 Surge Arresters, Medium- and High-Voltage

a. Visual and mechanical inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Inspect anchorage, alignment, grounding, and clearances.
- (4) Verify the arresters are clean.
- (5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (6) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

b. Electrical tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
- (2) Perform an insulation-resistance test on each arrester, phase terminal-to-ground.
- (3) Test grounding connection.

3.7.2 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, notify the Contracting Officer 5 working days in advance of the dates and times of checking and testing.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM

05/25

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

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 (2025) 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)

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

NEMA FU 1 (2012) Low Voltage Cartridge Fuses

NEMA ICS 1 (2022) Standard for Industrial Control and
Systems: General Requirements

NEMA ICS 2 (2000; R 2020) Industrial Control and
Systems Controllers, Contactors, and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Overload Relays Rated 600 V

NEMA ICS 4	(2015) Application Guideline for Terminal Blocks
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 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
NEMA RN 1	(2018) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
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 WD 1	(1999; R 2020) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2021) Wiring Devices Dimensions Specifications
NEMA Z535.4	(2023) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 1 2024; TIA 24-1) National Electrical Code
NFPA 70E	(2024) Standard for Electrical Safety in the Workplace

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

ANSI/TIA-568.1	(2020e) Commercial Building Telecommunications Infrastructure Standard
ANSI/TIA-569	(2019e; Add 1 2022) Telecommunications Pathways and Spaces
ANSI/TIA-607	(2019d) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.147 The Control of Hazardous Energy (Lock
Out/Tag Out)

29 CFR 1910.303 Electrical, General

UL SOLUTIONS (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 20 (2025) 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 (2024) 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 248-4 (2010; Reprint Apr 2019) Low-Voltage Fuses
- Part 4: Class CC Fuses

UL 248-8 (2011; Reprint Aug 2020) Low-Voltage Fuses
- Part 8: Class J Fuses

UL 248-10 (2011; Reprint Aug 2020) Low-Voltage Fuses
- Part 10: Class L Fuses

UL 248-12 (2011; Reprint Aug 2020) Low Voltage Fuses
- Part 12: Class R Fuses

UL 248-15 (2018) Low-Voltage Fuses - Part 15: Class
T Fuses

UL 360 (2013; Reprint Jan 2024) UL Standard for
Safety Liquid-Tight Flexible Metal Conduit

UL 467 (2022) UL Standard for Safety Grounding
and Bonding Equipment

UL 486A-486B (2025) UL Standard for Safety Wire
Connectors

UL 486C (2023; Reprint Feb 2025) UL Standard for
Safety Splicing Wire Connectors

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

UL 489	(2025) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 498	(2017; Reprint Jun 2024) UL Standard for Safety Attachment Plugs and Receptacles
UL 506	(2017; Reprint Jan 2022) UL Standard for Safety Specialty Transformers
UL 508	(2018; Reprint Jul 2021) UL Standard for Safety Industrial Control Equipment
UL 510	(2020; Dec 2022) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2024) UL Standard for Safety Metallic Outlet Boxes
UL 514B	(2012; Reprint Mar 2024) UL Standard for Safety Conduit, Tubing and Cable Fittings
UL 514C	(2014; Reprint Apr 2024) 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 854	(2020; Reprint Jul 2024) Standard for Service-Entrance Cables
UL 869A	(2006; Reprint Jun 2020) Reference Standard for Service Equipment
UL 870	(2016; Reprint Nov 2023) UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings
UL 943	(2016; Reprint Sep 2023) UL Standard for Safety Ground-Fault Circuit-Interrupters
UL 984	(1996; Reprint Sep 2005) Hermetic Refrigerant Motor-Compressors
UL 1004-1	(2012; Reprint Nov 2020) UL Standard for Safety Rotating Electrical Machines - General Requirements
UL 1063	(2017; Reprint Jun 2022) UL Standard for Safety Machine-Tool Wires and Cables
UL 1242	(2006; Reprint Apr 2022) UL Standard for

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Safety Electrical Intermediate Metal
Conduit -- Steel

UL 2043 (2023) Fire Test for Heat and Visible
Smoke Release for Discrete Products and
Their Accessories Installed in
Air-Handling Spaces

UL 4248-1 (2022) UL Standard for Safety Fuseholders
- Part 1: General Requirements

UL 4248-12 (2018; Reprint Feb 2022) UL Standard for
Safety Fuseholders - Part 12: Class R

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 RELATED REQUIREMENTS

Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS applies to this section, with the additions and modifications specified herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Panelboards;

Wireways;

Marking Strips Drawings;

SD-03 Product Data

Switches;

Receptacles;

Circuit Breakers;

Fuses;

Motor Controllers;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Manual Motor Starters;

Surge Protective Devices;

SD-06 Test Reports

600-volt Wiring Test;

Grounding System Test;

Ground-fault Receptacle Test;

SD-07 Certificates

Fuses;

SD-09 Manufacturer's Field Reports

SD-10 Operation and Maintenance Data

1.5 QUALITY ASSURANCE

1.5.1 Electrician Qualifications

Electrical work must be performed by qualified persons with verifiable credentials who are familiar with applicable code requirements. Verifiable credentials consist of State, National and Local Certifications or Licenses that a Master or Journeyman Electrician may hold, depending on work being performed.

1.5.2 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.5.3 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 is the minimum standard for workmanship.

1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

1.5.4.1 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 consecutive hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.6 NOT USED

1.7 WARRANTY

Provide equipment items supported by service organizations that are located within 250 miles of the equipment installation in order to render service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 SEISMIC REQUIREMENTS

Provide seismic work conforming to Section 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS and to Section 26 05 48 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT as indicated.

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40 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 in areas where not accessible or below a raised floor installation.

2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360, limited to 6 feet in areas where not accessible or below a raised floor installation. 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

Die Cast compression type.

2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.3 NOT USED 2.4 NOT USED 2.5 OPEN TELECOMMUNICATIONS CABLE SUPPORT

2.5.1 Open Top Cable Supports

Provide open top cable supports in accordance with UL 2043. Provide galvanized open top cable supports.

2.6 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.6.1 Outlet Boxes for Telecommunications System

Provide the following:

- a. Standard type 4 inches square by 2 1/8 inches deep .

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- b. Outlet boxes for wall-mounted telecommunications connections: 4 by 2 1/8 by 2 1/8 inches deep.
- c. Depth of boxes: large enough to allow manufacturers' recommended conductor bend radii.

2.7 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.

2.8 WIRES AND CABLES

Provide wires and cables in accordance with 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.

2.8.1 Conductors

Provide the following:

- a. Conductor sizes and capacities shown are based on copper, unless indicated otherwise.
- b. Conductors No. 10 AWG and larger diameter: stranded.
- c. Conductors No. 12 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.

2.8.1.1 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 accordance with DLVLC system manufacturer requirements.

2.8.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.8.2.1 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.

2.8.2.2 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
- c. 120/240 volt, single phase: Black and red

2.8.3 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, 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.

2.8.4 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

2.9 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.

2.10 DEVICE PLATES

Provide the following:

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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: satin finish stainless steel or brushed-finish aluminum, minimum 0.03 inch thick.
- e. Screws: machine-type with countersunk heads in color to match finish of plate.
- f. Sectional type device plates are not be permitted.
- g. Plates installed in wet locations: gasketed and UL listed for "wet locations."

2.11 SWITCHES

2.11.1 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. Do not use back-stabbed conductor terminals.
- 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.

2.11.2 Switch with Red Pilot Handle

NEMA WD 1. Provide the following:

- a. Pilot lights that are integrally constructed as a part of the switch's handle.
- b. Pilot light color: red and illuminate whenever the switch is closed or "on".
- c. Pilot lighted switch: rated 20 amps and 120 volts or 277 volts as indicated.
- d. The circuit's neutral conductor to each switch with a pilot light.

2.11.3 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

motor-disconnect means. Provide switches in NEMA 1, enclosure as indicated per NEMA ICS 6.

2.12 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch. Coordinate time-current characteristics curves of fuses serving motors or connected in series with circuit breakers for proper operation. Submit coordination data for approval. Provide fuses with a voltage rating not less than circuit voltage.

2.12.1 Fuseholders

Provide in accordance with UL 4248-1.

2.12.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 248-12, Class RK-1. Provide only Class R associated fuseholders in accordance with UL 4248-12.

2.12.3 Cartridge Fuses, High-Interrupting Capacity, Current Limiting Type (Classes J, L, and CC)

UL 248-8, UL 248-10, UL 248-4, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.

2.12.4 Cartridge Fuses, Current Limiting Type (Class T)

UL 248-15, Class T for zero to 1,200 amperes, 300 volts; and zero to 800 amperes, 600 volts.

2.13 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. Do not use back-stabbed conductor terminals.
- g. Grounding pole connected to mounting strap.
- h. The receptacle: containing triple-wipe power contacts and double or triple-wipe ground contacts.

2.13.1 Split Duplex Receptacles

Provide separate terminals for each ungrounded pole. One receptacle must be controlled separately.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.13.2 Weather Resistant Receptacles

Provide receptacles, UL listed for use in "wet locations" with integral GFCI protection. Include cast metal box with gasketed, hinged, lockable and weather resistant while-in-use, polycarbonate, UV resistant/stabilized extra-duty rated hood.

2.13.3 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.

2.14 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" 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.14.1 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.

2.14.2 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.

2.14.3 Circuit Breakers

UL 489, thermal magnetic-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 that do not use a retaining bolt are unacceptable.

2.14.3.1 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

breaker poles are connected to Phases A, B, and C, respectively.

2.14.3.2 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.

2.15 NOT USED 2.16 NOT USED 2.17 NOT USED 2.18 MOTORS

Provide motors in accordance with the following:

- a. NEMA MG 1.
- b. Hermetic-type sealed motor compressors: Also comply with UL 984.
- c. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified.
- d. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters.
- e. Rate motors for operation on 208-volt, 3-phase circuits with a terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits with a terminal voltage rating of 460 volts.
- f. Use motors designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.
- g. Unless otherwise indicated, use continuous duty type motors if rated 1 HP and above.
- h. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.
- i. Use Inverter-Rated motors designed to operate with adjustable speed drive (ASD).

2.18.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors: high efficiency types are not acceptable. In exception, for special purpose motors and motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.18.2 Premium Efficiency Polyphase and Single-Phase Motors

Select polyphase and continuous-duty single phase motors based on high efficiency characteristics relative to typical characteristics and applications as listed in NEMA MG 10 and NEMA MG 11. In addition, continuous rated, polyphase squirrel-cage medium induction motors must meet the requirements for premium efficiency electric motors in accordance with NEMA MG 1, including the NEMA full load efficiency ratings. In

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated. The rotor must be of a permanent magnet type supported by ball bearings to increase motor efficiency and longevity. The motor must maintain 70 percent or greater efficiency for its design application. ECM motors to comply with UL 1004-1.

2.18.3 Electronically Commutated Motors

Provide Electronically Commutated Motor (ECM) designed as a DC brushless motor for variable speed or constant speed motor control. ECM will be complete with and be operated by a single-phase or three-phase integrated controller/inverter. The integrated controller must sense rotor position and electronically commute the stator windings to provide synchronous rotation. AC power must be rectified, filtered and then converted to DC power. ECM controller must be capable of accepting a 0-10VDC or a 4-20mA signal for manual/automatic control. Ensure efficiency is a minimum of 70 percent over the motors entire operating range.

2.18.4 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.18.5 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment using adjustable speed drive (ASD) manufacturer required wiring type and lengths as specified herein. Power wiring and conduit: conform to the requirements specified herein. Control wiring: provided under, and conform to, the requirements of the section specifying the associated equipment.

2.19 MOTOR CONTROLLERS

Provide motor controllers in accordance with the following:

- a. UL 508, NEMA ICS 1, and NEMA ICS 2.
- b. Provide controllers with thermal overload protection in each phase, and one spare normally open auxiliary contact, and one spare normally closed auxiliary contact.
- c. Provide controllers for motors rated 1-hp 746 watts and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage.
- d. Provide protection for motors from immediate restart by a time adjustable restart relay.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- e. When used with pressure, float, or similar automatic-type or maintained-contact switch, provide a hand/off/automatic selector switch with the controller.
- f. Connections to selector switch: wired such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position.
- g. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices: connected in motor control circuit in "hand" and "automatic" positions.
- h. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device: made in accordance with indicated or manufacturer's approved wiring diagram.
- i. Provide a disconnecting means, capable of being locked in the open position, for the motor that is located in sight from the motor location and the driven machinery location. As an alternative, provide a motor controller disconnect, capable of being locked in the open position, to serve as the disconnecting means for the motor if it is in sight from the motor location and the driven machinery location.
- j. Overload protective devices: provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case.
- k. Cover of combination motor controller and manual switch or circuit breaker: interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

2.19.1 Control Wiring

Provide control wiring in accordance with the following:

- a. All control wire: stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44, or Type MTW meeting UL 1063, and passing the VW-1 flame tests included in those standards.
- b. Hinge wire: Class K stranding.
- c. Current transformer secondary leads: not smaller than No. 10 AWG .
- d. Control wire minimum size: No. 14 AWG .
- e. Power wiring for 480-volt circuits and below: the same type as control wiring with No. 12 AWG minimum size.
- f. Provide wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.19.2 Control Circuit Terminal Blocks

Provide control circuit terminal blocks in accordance with the following:

- a. NEMA ICS 4.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- b. Control circuit terminal blocks for control wiring: molded or fabricated type with barriers, rated not less than 600 volts.
- c. Provide terminals with removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts.
- d. Terminals: not less than No. 10 in size with sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal.
- e. Terminal arrangement: subject to the approval of the Contracting Officer with not less than four spare terminals or 10 percent, whichever is greater, provided on each block or group of blocks.
- f. Modular, pull apart, terminal blocks are acceptable provided they are of the channel or rail-mounted type.
- g. Submit data showing that any proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.19.2.1 Types of Terminal Blocks

- a. Short-Circuiting Type: Short-circuiting type terminal blocks: furnished for all current transformer secondary leads with provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks: comply with the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.
- b. Load Type: Load terminal blocks rated not less than 600 volts and of adequate capacity: provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits, except those for feeder tap units. Provide terminals of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, provide screws with hexagonal heads. Conducting parts between connected terminals must have adequate contact surface and cross-section to operate without overheating. Provide each connected terminal with the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.19.3 Control Circuits

Control circuits: maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers: conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits: provide primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. Provide fuses in each ungrounded primary feeder. Provide one fused secondary lead with the other lead grounded. For designated systems, as indicated, provide backup power supply, including transformers connected to emergency power source. Provide for automatic switchover and alarm upon failure of primary control circuit.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.19.4 Enclosures for Motor Controllers

NEMA ICS 6.

2.19.5 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked.
Multiple-speed controllers: include compelling relays and multiple-button, station-type with pilot lights for each speed.

2.19.6 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations: heavy duty, oil-tight design.

2.19.7 Pilot and Indicating Lights

Provide LED cluster lamps.

2.20 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single pole designed for surface mounting with overload protection.

2.21 NOT USED 2.22 NOT USED 2.23 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.

2.24 NOT USED 2.25 GROUNDING AND BONDING EQUIPMENT

2.25.1 Ground Rods

UL 467. Ground rods: cone pointed copper-clad steel, with minimum diameter of 3/4 inch and minimum length 10 feet. Sectional type rods may be used for rods 20 feet or longer.

2.26 NOT USED 2.27 NAMEPLATES AND SIGNS

2.27.1 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.

2.27.2 Field Fabricated Nameplates

Provide field fabricated nameplates in accordance with the following:

- a. ASTM D709.
- b. Provide laminated plastic nameplates for each equipment enclosure,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.
- e. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.
- f. Minimum size of nameplates: one by 2.5 inches.
- g. Lettering size and style: a minimum of 0.25 inch high normal block style.

2.27.3 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.

2.28 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00 FIRESTOPPING.

2.29 WIREWAYS

UL 870. Material: steel epoxy painted 16 gauge for heights and depths up to 6 by 6 inches, and 14 gauge for heights and depths up to 12 by 12 inches. Provide in length required for the application with hinged cover NEMA 1 enclosure per NEMA ICS 6.

2.30 NOT USED

2.31 NOT USED

2.32 NOT USED

2.33 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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.

2.34 NOT USED

2.35 COORDINATED POWER SYSTEM PROTECTION

Prepare analyses as specified in Section 26 05 73 POWER SYSTEM STUDIES.

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 Underground Service

Underground service conductors and associated conduit: continuous from service entrance equipment to outdoor power system connection.

3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures: labeled and identified as such.

3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, label each enclosure, new and existing, as one of several enclosures containing service entrance disconnect devices. Label, at minimum: indicate number of service disconnect devices housed by enclosure and indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure: provided only as permitted by NFPA 70.

3.1.3 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. 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 Section 07 84 00 FIRESTOPPING.

3.1.3.1 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.

3.1.4 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.

3.1.4.1 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).

3.1.4.2 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.

3.1.4.3 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.4.4 Underground Conduit

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating: extend minimum 6 inches above floor.

3.1.4.5 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.

3.1.4.6 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.

3.1.4.7 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.4.8 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.

3.1.4.9 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 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.

3.1.4.10 Telecommunications and Signal System Pathway

Install telecommunications pathway in accordance with ANSI/TIA-569.

- a. Horizontal Pathway: Telecommunications pathways from the work area to the telecommunications room: installed and cabling length requirements in accordance with ANSI/TIA-568.1. Size conduits, wireways in accordance with ANSI/TIA-569.

3.1.5 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.

3.1.6 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 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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. 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.

3.1.6.1 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.

3.1.6.1.1 Wall-Mounted Telecommunications Outlet Box

Provide double gang electrical boxes, minimum standard size 4-11/16 inches square and 2-1/8 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.

3.1.6.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, 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.

3.1.7 Mounting Heights

Mount panelboards, circuit breakers, 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 and handicapped telecommunications stations 48 inches above finished floor. Mount receptacles and telecommunications outlets 18 inches above finished floor, unless otherwise indicated. Mount other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.8 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

terminations in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC manufacturer's recommendations. Provide telecommunications system conductor identification as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS.

3.1.8.1 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.

3.1.9 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.

3.1.10 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.

3.1.10.1 Circuit Identification

Indicate the electrical source(s) for the conductors supplying the receptacles and light switches at a given cover/device plate using a 'Panel-Circuit Number' naming convention (e.g., L1-23 for a circuit supplied from Panel L1, Pole Number 23). Labels must be black on a white

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

field. Labels must be digitally printed; handwritten labels are unacceptable. Stenciled lettering must be provided using thermal ink transfer process.

3.1.11 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.12 Grounding and Bonding

Provide in accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, and neutral conductor of wiring systems.

Make ground connection to driven ground rods on exterior of building. Bond additional driven rods together with a minimum of 4 AWG soft bare copper wire buried to a depth of at least 12 inches. In addition to the requirements specified herein, provide telecommunications grounding in accordance with ANSI/TIA-607. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.12.1 Ground Rods

Provide ground rods and measure the resistance to ground using the fall-of-potential method described in IEEE 81. Do not exceed 25 ohms under normally dry conditions for the maximum resistance of a driven ground. If this resistance cannot be obtained, provide 2 additional rods, spaced on center. Spacing for additional rods must be a minimum of 10 feet. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

3.1.12.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, 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.

3.1.12.3 Resistance

Maximum resistance-to-ground of grounding system: do not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.13 Equipment Connections

Provide power wiring and connections to motors and equipment. 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.

3.1.14 Repair of Existing Work

Perform repair of existing work, demolition, and modification of existing electrical distribution systems as follows:

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

Painting: as specified in Section 09 90 00 PAINTS AND COATINGS.

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. 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 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.

3.5.4 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

3.5.5 Phase Rotation Test

Perform phase rotation test to ensure proper rotation of service power prior to operation of new or reinstalled equipment using a phase rotation meter. Follow the meter manual directions performing the test.

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 (2022) 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

NEMA ICS 7.2	(2015) Application Guide for AC Adjustable Speed Drive Systems
NEMA ICS 61800-2	(2005) Adjustable Speed Electrical Power Drive Systems Part 2: General Requirements - Rating Specifications for Low Voltage Adjustable Frequency A.C. Power Drive Systems
NEMA MG 1	(2021) Motors and Generators
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(2023; ERTA 1 2024; TIA 24-1) National Electrical Code
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
47 CFR 15	Radio Frequency Devices
UL SOLUTIONS (UL)	
UL 489	(2025) 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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" or "S" classification. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Schematic Diagrams;
Interconnecting Diagrams;
Installation Drawings;
As-Built Drawings;

SD-03 Product Data

Adjustable Speed Drives;
Wires and Cables
Equipment Schedule

SD-06 Test Reports

ASD Test
Performance Verification Tests
Endurance Test

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

ASD Test Plan;
Standard Products

SD-10 Operation and Maintenance Data

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Adjustable Speed Drives, Data Package 4

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

Provide one spare ASD of each model provided for HVAC equipment, fully programmed and ready for back-up operation when connected.

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

Adjust decelerating time by providing an external dynamic braking resistor designed to meet NEMA ICS 61800-2 to be capable of decelerating six times the motor inertia with no more than 150 percent of rated current with the motor at its base speed. 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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. have sensor in each phase, Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing, Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting, analog communication module, .
- 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,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 properly 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.1.1.1 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- i. 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.
- j. 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- (d) Over voltage from utility power.
- (e) Motor running overload.
- (f) Over voltage during deceleration.
- (g) ASD over heat.
- (h) Load and ground fault.
- (i) 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 with the assistance of a factory-authorized service representative.

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- f. Failure recovery procedures
- g. Troubleshooting and repair
- h. Maintenance and calibration
- i. System programming and configuration

-- End of Section --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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	(2024) 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Packages, Arrays and Modules

ANSI/IES LS-1	(2020) Lighting Science: Nomenclature and Definitions for Illuminating Engineering
ANSI/IES TM-21	(2021) Technical Memorandum: Projecting Long-Term Luminous, 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 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.377	(2024) 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 1 2024; TIA 24-1) National
---------	--

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Electrical Code

NFPA 101 (2024) Life Safety Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15 Radio Frequency Devices

UL SOLUTIONS (UL)

UL 20 (2025) UL Standard for Safety General-Use Snap Switches

UL 94 (2023; Reprint Jan 2024) 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 916 (2015; Reprint Oct 2021) UL Standard for Safety Energy Management Equipment

UL 924 (2016; Reprint Feb 2025) UL Standard for Safety Emergency Lighting and Power Equipment

UL 1472 (2015) UL Standard for Safety Solid-State Dimming Controls

UL 1598 (2021; Reprint Jan 2024) UL Standard for Safety Luminaires

UL 2043 (2023) Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces

UL 8750 (2020; Reprint Aug 2024) 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. Cybersecurity requirements are specified in Section 25 05 11. CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS. 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

SD-02 Shop Drawings

Luminaire Drawings;
Occupancy/Vacancy Sensor Coverage Layout; S
Lighting Control System One-Line Diagram;
Sequence of Operation for Lighting Control System;

SD-03 Product Data

Luminaires;
Light Sources;
LED Drivers;
Luminaire Warranty;
Lighting Controls Warranty;
Local Area Controller;
Lighting Relay Panel;
Lighting Control Panel;
Gateway;
Lighting Contactor;
Switches;
Digital Switch Timers;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- Wall Box Dimmers;
- Scene Wallstations;
- Occupancy/Vacancy Sensors;
- Photosensors;
- Time Clocks;
- Power Packs;
- Power Hook Luminaire Hangers;
- Mini Inverters;
- Exit Signs;
- Emergency Drivers;
- Energy Star Label For Residential Luminaires; S
- Linear LED Lamps;

SD-05 Design Data

- Luminaire Design Data;
- Photometric Plan;

SD-06 Test Reports

- ANSI/IES LM-79 Test Report;
- ANSI/IES LM-80 Test Report;
- ANSI/IES TM-21 Test Report;
- ANSI/IES TM-30 Test Report;
- Occupancy/Vacancy Sensor Verification Test;
- Photosensor Verification Test;

SD-07 Certificates

- LED Driver and Dimming Switch Compatibility Certificate;

SD-10 Operation and Maintenance Data

- Lighting System, Data Package 5;
- Lighting Control System, Data Package 5;
- Maintenance Staff Training Plan;
- End-User Training Plan;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

manufacturer that ensures compatibility and operability between devices without flickering and to specified dimming levels.

1.5.8 Occupancy/Vacancy Sensor Coverage Layout

Provide floor plans showing coverage layouts of all devices using manufacturer's product information.

1.5.9 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.

1.5.10 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.

1.5.11 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.

1.5.11.1 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.

1.5.11.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than six months prior to date of delivery to site, unless specified otherwise.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- (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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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
High Bay, Low Bay, and Industrial Locations	100 LPW
Food Service and Hazardous Locations	60 LPW
Other (track, residential diffusers)	50 LPW
Exterior Wall Sconce	50 LPW
Steplight	30 LPW
Parking Garage Luminaire	100 LPW

- e. UL listed for dry or damp location typical of interior installations.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- 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.

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

CEC Title 20. 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. Fidelity index greater than or equal to 80, gamut index between 97 and 110, determined in accordance with ANSI/IES TM-30.
- 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.
- e. Color maintenance value of no greater than 0.003 ($\Delta u'v'$) at 6000 hours as listed in ANSI/IES LM-79 Test Report.

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 Centralized Control Systems Provide a centralized lighting control system capable of manual control, time-based control, receiving input from photosensors and occupancy/vacancy sensors, with the capabilities of controlling, monitoring, and programming changes from one centralized on-site location, and integration with other building systems.

2.5.1.1.1 Lighting Control Panel

UL 916, 47 CFR 15. Provide an electronic, programmable lighting control panel complete with microprocessor, capable of providing lighting control with input from internal programming, digital switches, time clocks, and other control devices.

Enclose panel hardware in a surface-mounted, NEMA 1, painted, steel enclosure with lockable access door and ventilation openings. Internal low-voltage compartment must be separated from line-voltage compartment of enclosure with only low-voltage compartment accessible upon opening of door. Provide additional remote cabinets that communicate back to main control panel as required. Provide Lighting Control Panels that meet the following criteria:

- a. Input voltage of 120-277 at 50/60 Hz, with internal low-voltage VDC power supply as required.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- b. Solid-state, microprocessor-based, internal astronomical time clock. Microprocessor must have nonvolatile memory and must reset automatically after power interruptions of up to 90 days.
- c. Interface for providing local programming and control capability, with physical key-locked cover or programmed security access code to prevent unauthorized use.
- d. Dimming modules capable of 0-10V dimming.
- e. Modules and control panels include multichannel output with 42 channels, with multiple inputs for manual control, photosensors, and occupancy/vacancy sensors.
- f. Control processor is configured to interface with BACnet in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS compliant network via native compatibility.
- g. Outputs that require line-voltage switching are provided by relays which are designed for 10 years of use at full rated load.
- h. Control processor indicates failure of normal power and which circuits are supplied by alternative power source if connected to emergency lighting units.

j. 2.5.1.1.2 Gateway

Provide gateway in accordance with Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION. Provide hardware and software to enable the BAS to monitor, control, display, and record data for use in processing reports. Provide BACnet communication interface that enables remote control and monitoring of lighting from a workstation according to read access points and write access points listed in this section. Control features and monitoring points displayed locally at lighting panel must be available through the Gateway. Provide Gateway that meets the following requirements:

- a. Microprocessor-based communications device that perform bi-directional protocol translation.
- b. Support full bi-directional communication and translation.
- c. Contain its own microprocessor, RAM, battery, communication ports, and power supply.
- d. Support an additional 5 percent points for future expansion.

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 part of a lighting control system.
- 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 project plans. 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 120-277 volts.
- b. Time delay of 30 seconds to 30 minutes with at least four intermediate time delay settings.
- c. Sensors are ceiling mounted.
- d. Does not exceed a maximum load requirement of 20mA at 24VDC. No minimum load requirement and be capable of switching from zero to 800 W at 120 VAC, 50/60 Hz and from zero to 1200 W at 277 VAC, 50/60 Hz.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Networked sensor with no minimum or maximum load. Sensor is programmed to control zones.

- 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 via lighting control system processor..
- 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.
- j. 2.5.2.4.1 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.

2.5.2.4.2 High Bay Sensors

Provide occupancy/vacancy sensors specifically designed for high-bay mounting applications for all ceiling-mounted sensors mounted above 35 feet using PIR technology. Provide high-bay sensors with interchangeable lenses for 360 degree open area coverage or narrow rectangular warehouse aisle coverage. Provide sensors that are designed to mount directly to or adjacent to high- or low-bay luminaires.

2.5.2.4.3 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 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. Edge-lit type with

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

clear acrylic, edge-lit face and aluminum trim having clear finish.

- b. UL listed for damp location.
- c. Configured for universal ceiling wall 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. In lieu of battery, can use a nonradioactive photoluminescent plate.

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 as indicated, 10-50 VDC compatible 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 pendants 4 feet or longer to limit swinging. Provide with swivel hangers to ensure a plumb installation for rigid stem pendants. Provide cadmium-plated steel with a swivel-ball tapped for the conduit size indicated.
- c. Single-unit suspended luminaires must have twin-stem hangers.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

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 N04400, 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.

2.7.4 Power Hook Luminaire Hangers

UL 1598. Provide an assembly consisting of through-wired power hook housing, interlocking plug and receptacle, power cord, and luminaire support loop. Power hook housing must be cast aluminum having two 3/4 inch threaded hubs. Support hook must have safety screw. Luminaire support loop must be cast aluminum with provisions for accepting 3/4 inch threaded stems. Power cord must include 16 inches of 3 conductor No. 16 Type SO cord. Assembly must be rated 120 volts or 277 volts, 15 amperes.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

2.9 FACTORY APPLIED FINISH

NEMA 250. Provide all luminaires and lighting equipment with factory-applied painting system that as a minimum, meets requirements of corrosion-resistance testing.

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 pendants 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

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 Scene Wallstations

Submit labeling templates for all scene wallstations, ganged faceplates and other manual control cover plates. Label each scene control button with approved scene description.

3.1.5.2 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 photosensors operate as described in sequence of operations. Provide testing of sensor coverage, aiming, and calibration in all spaces where sensors are placed. This is to be completed only after all furnishings have been installed. Submit photosensor verification test.
- c. 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 (2020) American National Standard Method
for Measuring the Intelligibility of
Speech Over Communication Systems (ASA 85)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A17.1/CSA B44 (2022) Safety Code for Elevators and
Escalators

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide
<https://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 1 2024; TIA 24-1) National
Electrical Code

NFPA 72 (2022; ERTA 22-1) National Fire Alarm and
Signaling Code

NFPA 90A (2024) Standard for the Installation of
Air Conditioning and Ventilating Systems

NFPA 170 (2024; ERTA 1 2023) Standard for Fire
Safety and Emergency Symbols

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-601-02	(2021) Fire Protection Systems Inspection, Testing, and Maintenance
UFC 4-010-06	(2023) Cybersecurity of Facility-Related Control Systems

UL SOLUTIONS (UL)

UL 464	(2023) 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 Feb 2022) UL Standard for Safety Protectors for Data Communications and Fire Alarm Circuits
UL 864	(2023; Reprint Oct 2024) UL Standard for Safety Control Units and Accessories for Fire Alarm Systems
UL 1283	(2017; Reprint Feb 2024) UL Standard for Safety Electromagnetic Interference Filters
UL 1449	(2021; Reprint Dec 2022) UL Standard for Safety Surge Protective Devices
UL 1480	(2023) UL Standard for Safety Speakers for Fire Alarm and Signaling Systems, Including Accessories
UL 1638	(2023) UL Standard for Safety Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
UL 1971	(2002; Reprint Feb 2024) UL Standard for Safety Signaling Devices for the Deaf and Hard of Hearing
UL 2017	(2008; Reprint Jan 2024) 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	UL Product IQ (updated online) at https://productiq.ulprospector.com/en

1.2 RELATED SECTIONS

Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS, applies to this section, with the additions and modifications specified herein. In addition, refer to the following sections for related work and

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

coordination:

Section 21 13 13 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION
Section 21 30 00 FIRE PUMPS
Section 23 30 00 HVAC AIR DISTRIBUTION
Section 08 71 00 DOOR HARDWARE for door unlocking and additional work related to finish hardware.
Section 07 84 00 FIRESTOPPING for additional work related to firestopping.

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. Existing interior fire alarm system was manufactured by Simplex. Design and installation must comply with UFC 4-010-06.
- 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. Where a fire pump is provided, the fire alarm and mass notification system must monitor and transmit the fire pump controller signals in accordance with the provisions of NFPA 72.
- e. Where an emergency generator provides standby power supply for life safety system circuits, the generator must be monitored by the FMCU and transmit emergency generator signals in accordance with NFPA 72.
- f. 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 or building occupants to operate the MNS including delivery of recorded messages 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 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" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.

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, G

Fire alarm system designer; G, G

Supervisor; G, G

Technician; G, G

Installer; G, G

Test Technician; G, G

Fire Alarm System Site-Specific Software Acknowledgement; G, G

SD-02 Shop Drawings

Nameplates; G, G

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Instructions; G, G
Wiring Diagrams; G, G
System Layout; G, G
Notification Appliances; G, G
Initiating devices; G, G
Amplifiers; G, G
Battery Power; G, G
Voltage Drop Calculations; G, G

SD-03 Product Data

Fire Alarm and Mass Notification Control Unit (FMCU); G, G
Local Operating Console (LOC); G, G
Amplifiers; G, G
Tone Generators; G, G
Digitalized voice generators; G,
Video Display Unit (VDU); G, G
LCD Annunciator; G, G
Manual Stations; G, G
Smoke Detectors; G, G
Duct Smoke Detectors; G,
Heat Detectors; G,
Addressable Interface Devices; G, G
Addressable Control Modules; G, G
Isolation Modules; G, G
Notification Appliances; G, G
Textual Display Sign Control Panel; G, G
Textual Display Signs; G, G
Batteries; G, G
Battery Chargers; G, G
Surge Protective Devices; G, G
Alarm Wiring; G,

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

Back Boxes and Conduit; G, G

Terminal Cabinets; G, G

Digital Alarm Communicator Transmitter (DACT); G,

Electromagnetic Door Holders; G, G

Environmental Enclosures or Guards; G,

Document Storage Cabinet; G, G

SD-05 Design Data

SD-06 Test Reports

Test Procedures; G, G

SD-07 Certificates

Verification of Compliant Installation; G, G

Request for Government Final Test; G, G

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G, G

Instruction of Government Employees; G, 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) Existing class , or to signaling line circuits (SLC) Class Existing

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

class and installed in accordance with NFPA 72.

- b. Connect notification appliances to notification appliance circuits (NAC) Existing Class .

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 circuits, air 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 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 a remote supervising station.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- (2) Visual indication of the device operated on the FMCU, .(3)
Actuation of alarm notification appliances.
 - (4) Recording of the event electronically in the history log of the FMCU.
 - (5) Release of doors held open by electromagnetic devices.
 - (6) Operation of a sprinkler waterflow switch serving an elevator machinery room or elevator shaft must operate shunt trip circuit breaker(s) to shut down power to the elevators in accordance with ASME A17.1/CSA B44.
- m. A supervisory signal must automatically initiate the following functions:
- (1) Visual indication of the device operated on the FMCU, and on the remote annunciator. Indication on the graphic annunciator must be by floor, zone or circuit, and type of device.
 - (2) Transmission of a supervisory signal to a remote supervising station.
 - (3) 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.
 - (4) 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. Indication on the graphic annunciator must be by floor, zone or circuit, and type of device.
 - (2) Transmission of a trouble signal to a remote supervising station.
 - (3) 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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. The supervising equipment is existing and consists of the following brands and models: supervising station control unit ., annunciator .
- 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.
- c. Equipment and devices must be compatible and operable with the existing installation-wide mass notification system and must not impair reliability or operational functions of the existing system. The installation-wide mass notification system utilizes transceivers.

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

2 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

2 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

2 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 IV (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 IV 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

NICET Level II technician 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

drawings.

1.9.2.5 Test Technician

Fire alarm technicians with a minimum of eight years of experience and NICET Level IV 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. Two of each type of detector base and head installed.
- e. One smoke detector manufacturer's test screen, card or magnet for each ten beam smoke detectors, or fraction thereof, installed in the system.
- f. of each type of audible and visual alarm device installed.
- g. One textual visual notification appliance.
- h. Two of each type of addressable monitor module installed.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

- i. Two of each type of addressable control module installed.
- j. Two low voltage, one , and one 120 VAC surge protective device.

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. Master all keys and locks to a single key as required by the Installation Fire Department. Keys must be CAT 60.

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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. 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 selectable by zone, or all call. The system must be capable of operating all speakers at the same time. The Audible Notification System must support Public Address (PA) paging for the facility. Activation of the public address microphone must not initiate activation of visual notification appliances or LED text displays.
- 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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, and public address (PA) functions. 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 than all other messages (except any "test" messages) and must not override any other messages. If not manually ended, any mass notification announcement will automatically end after 10 minutes.
- c. 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.

2.3.4.3 Installation-Wide Control

If an installation-wide control system for mass notification exists on the Base, the autonomous control unit must communicate with the central control unit of the Installation-wide system. The autonomous control unit must receive commands/messages from the central control unit and provide status information.

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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 and on the system printer, 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 ADDRESSABLE INTERFACE DEVICES

The initiating device being monitored must be configured as a Existing Class 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. Existing fire alarm system initiating device circuits must be connected to a single module to supervise the circuit. Modules must be listed for the environmental conditions in which they will be installed.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.5 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 Existing Class 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.

2.6 NOTIFICATION APPLIANCES

2.6.1 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 per the direction of the Architect. Recessed audible appliances must be installed with a grill that is painted Per the direction of the Architect.

2.6.1.1 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.

2.6.2 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).

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 30 candela based on the UL 1971 test. Strobe must be surface mounted.

2.6.3 Textual Display Signs

2.7 ELECTRIC POWER

2.7.1 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.

2.8 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.

2.8.1 Batteries

Provide sealed, maintenance-free, gel cell 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 battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.

2.8.1.1 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.

2.8.1.2 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 devices or appliances remote from the power sources.

2.8.2 Battery Chargers

Provide a 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.

2.9 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

2.10 WIRING

Provide wiring materials under this section as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM with the additions and modifications specified herein.

2.10.1 Alarm Wiring

IDC and SLC wiring must be fiber optic or solid copper or stranded copper cable in accordance with the manufacturers requirements. Copper signaling line circuits and initiating device circuit field wiring must be No. 14 AWG size conductors at a minimum. Visual notification appliance circuit conductors, that contain audible alarm appliances, must be copper No. 16 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 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.

2.11 SYSTEM MONITORING

2.11.1 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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. RecessSemi-recessSurface 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. Manual stations must be mounted at 44 inches measured to the operating handle.

3.2.4 Notification Appliances

- a. Locate notification appliance devices as required by NFPA 72. 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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 and Heat Detectors

Locate detectors as required by NFPA 72 and their listing on a 4-inch mounting box. Install heat detectors not less than 4 inches from a side wall to the near edge. Heat detectors located on the wall must have the top of the detector at least 4 inches below the ceiling, but not more than 12 inches below the ceiling. Smoke detectors are permitted to be on the wall no lower than 12 inches from the ceiling with no minimum distance from the ceiling. In raised floor spaces, install the smoke detectors to protect 225 square feet per detector. 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 shown on the drawings. Mount the annunciator, with the top 6 feet above the finished floor or center the annunciator at 5 feet, whichever is lower.

3.2.7 Local Operating Console (LOC)

Locate the LOC(s) as required by NFPA 72 and as indicated. Mount the console so that the top message button and microphone is no higher than 4 feet above the floor and the bottom (lowest) message button and microphone is at least 3 feet above the finished floor.

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 professional 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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, notification appliance circuits and signaling line circuits 6 feet in length or less. 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.

3.3.5 Conductor Terminations

Labeling of conductors at terminal blocks in terminal cabinets, 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 DISCONNECTION AND REMOVAL OF EXISTING SYSTEM

Maintain existing fire alarm/mass notification equipment fully operational until the new equipment has been tested and accepted by the Contracting Officer. As new equipment is installed, label it "NOT IN SERVICE" until the new equipment is accepted. Once the new system is completed, tested, and accepted by the Government, it must be placed in service and connected to the supervising station. Remove tags from new equipment and tag the existing equipment "NOT IN SERVICE" until removed from the building.

- a. After acceptance of the new system by the Contracting Officer, remove existing equipment not connected to the new system, remove unused exposed conduit, and restore damaged surfaces. Remove the material from the site and dispose.
- b. Disconnect and remove the existing fire alarm/mass notification and smoke detection systems where indicated and elsewhere in the specification.
- c. Control units and fire alarm devices and appliances disconnected and removed must be turned over to the Contracting Officer.
- d. Properly dispose of fire alarm outlet and junction boxes, wiring, conduit, supports, and other such items.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.5 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.

3.6 FIRESTOPPING

Provide firestopping for holes at conduit penetrations through floor slabs, fire-rated walls, partitions with fire-rated doors, corridor walls, and vertical service shafts in accordance with Section 07 84 00 FIRESTOPPING.

3.7 PAINTING

- a. In unfinished areas (including areas above drop ceilings), paint all exposed electrical conduit (serving fire alarm equipment), fire alarm conduit, surface metal raceway, junction boxes and covers red. In lieu of painting conduit, the contractor may utilize red conduit with a factory applied finish.
- 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.
- c. Painting must comply with Section 09 90 00 PAINTS AND COATINGS.

3.8 FIELD QUALITY CONTROL

3.8.1 Test Procedures

Submit detailed test procedures, prepared and signed by the NICET Level IV Fire Alarm Technician, and the representative of the installing company, 60 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

3.8.2 Pre-Government Testing

3.8.2.1 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.

3.8.2.2 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.

3.8.3 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.

3.8.4 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). At this time, any and all required tests noted in the paragraph "Minimum System Tests" must be repeated at their discretion.

3.9 MINIMUM SYSTEM TESTS

3.9.1 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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".

3.9.2 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.9.3 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 between 0.7 and 0.8. 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.

3.10 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

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

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.
- 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.

In existing buildings, the transfer of devices from the existing system to the new system and the permission to begin demolition of the old fire alarm system will not be permitted until the as-built drawings and O&M manuals are received.

3.11 INSTRUCTION OF GOVERNMENT EMPLOYEES

3.11.1 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.

3.11.2 Required Instruction Time

Provide 16 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 fire department responses.

3.11.2.1 Technical Training

Equipment manufacturer or a factory representative must provide 3 days of on site and 5 days of technical training to the Government at the manufacturing facility. 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.

3.11.3 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.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.12 EXTRA MATERIALS

3.12.1 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.

3.12.2 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.

3.12.3 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 --

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SECTION 33 71 01

OVERHEAD TRANSMISSION AND DISTRIBUTION

05/19, CHG 1: 11/19

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 B16.11 (2021) Forged Fittings, Socket-Welding and Threaded

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M (2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A123/A123M (2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153/A153M (2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A575 (2020) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

ASTM A576 (2025) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality

ASTM B117 (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM B857 (2018) Standard Specification for Shaped Wire Compact Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Supported (ACSS/TW)

ASTM D709 (2017) Standard Specification for Laminated Thermosetting Materials

ASTM D1654 (2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

IEEE 404	(2012) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
IEEE C2	(2023) National Electrical Safety Code
IEEE C37.30.1	(2011) Standard Requirements for AC High-Voltage Air Switches Rated Above 1000 V
IEEE C135.1	(1999) Standard for Zinc-Coated Steel Bolts and Nuts for Overhead Line Construction
IEEE C135.2	(1999) Threaded Zinc-Coated Ferrous Strand-Eye Anchor Rods and Nuts for Overhead Line Construction
IEEE C135.22	(1988) Standard for Zinc-Coated Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
----------	--

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 71/ICEA S-96-659	(2014; R 2022) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA WC 70	(2021) Power Cable Rated 2000 Volts or Less for the Distribution of Electrical Energy
NEMA WC 74/ICEA S-93-639	(2022) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy
NEMA/ANSI C29.7	(1996; 2002) American National Standard for Wet Process Porcelain Insulators - High-Voltage Line Post Type

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 1 2024; TIA 24-1; TIA 25-2) National Electrical Code
---------	--

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 202-1	(2004) List of Materials Acceptable for Use on Systems of RUS Electrification Borrowers
-----------	---

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

UL SOLUTIONS (UL)

UL 6	(2022) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 510	(2020; Dec 2022) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, must be as defined in IEEE 100.

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 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-03 Product Data

Conductors;

Insulators;

Nameplates;

Pole Top Switch;

Cutouts;

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

SD-06 Test Reports

Field Quality Control;

Ground Resistance Test Reports;

Medium-Voltage Preassembled Cable Test;

Low-Voltage Cable Test;

Acceptance Checks and Tests;

SD-09 Manufacturer's Field Reports

Operation and Maintenance Manuals;

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, Data Package 5;

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory except of NFPA 70 when more stringent

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

requirements are specified or indicated, 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. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 and IEEE C2 unless more stringent requirements are specified or indicated.

1.5.2 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. Products must have been in satisfactory commercial or industrial use for 2-years prior to bid opening. The 2-year 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 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.

1.5.2.1 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.

1.5.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site must not be used, unless specified otherwise.

1.5.3 Ground Resistance Test Reports

Submit the measured ground resistance of grounding system. When testing grounding electrodes and grounding systems, identify each grounding electrode and each grounding system for testing. Include the test method and test setup (i.e. pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

1.6 OPERATIONS AND MAINTENANCE DATA

Provide operation and maintenance manuals for systems in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provides basic data relating to the design, operation, and maintenance of the electrical distribution system.

1.6.1 Additions to Operations and Maintenance Data

In addition to requirements of Data Package 5, include the following in the operation and maintenance manuals provided:

- a. Assembly and installation drawings
- b. Prices for spare parts and supply list
- c. Date of purchase

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

1.7 DELIVERY, STORAGE, AND HANDLING

Devices and equipment must be visually inspected by the Contractor when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Replace damaged items. Store oil filled transformers and switches in accordance with the manufacturer's requirements.

1.8 WARRANTY

The equipment items must 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.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Consider materials specified herein or shown on contract drawings which are identical to materials listed in RUS 202-1 as conforming to requirements. Provide equipment and component items, not hot-dip galvanized or porcelain enamel finished, with corrosion-resistant finishes which must withstand 120 hours of exposure to the salt spray test specified in ASTM B117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. Provide the described test mark and test evaluation in accordance with ASTM D1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Coat cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel with a zinc rich paint conforming to the manufacturer's standard.

2.2 NOT USED

2.3 NOT USED

2.4 HARDWARE

Hardware must be hot-dip galvanized in accordance with ASTM A153/A153M and ASTM A123/A123M.

Zinc-coated hardware must comply with IEEE C135.1, IEEE C135.2, IEEE C135.22. Steel hardware must comply with ASTM A575 and ASTM A576. Pole-line hardware must be hot-dip galvanized steel. Install washers under boltheads and nuts on wood surfaces and elsewhere as required. Washers used on through-bolts and double-arming bolts must be approximately 2-1/4 inches square and 3/16 inch thick. The diameter of holes in washers must be the correct standard size for the bolt on which a washer is used. Washers for use under heads of carriage-bolts must be of the proper size to fit over square shanks of bolts. Use eye bolts, bolt eyes, eyenuts, strain-load plates, lag screws, guy clamps, fasteners, hooks, shims, and clevises wherever required to support and to protect poles, brackets, crossarms, guy wires, and insulators.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.5 INSULATORS

Provide wet-process porcelain insulators which are radio interference free.

- a. Line post type insulators: NEMA/ANSI C29.7, Class 57-1.
- b.

2.6 NOT USED

2.7 NEUTRAL-SUPPORTED SECONDARY AND SERVICE DROP CABLES

Service cables must be aluminum, triplex with cross-linked polyethylene insulation on the phase conductors. Neutral must be bare ACSR and must be the same size as the phase conductors unless otherwise indicated. Cables shall conform to NEMA WC 70 and ANSI/NEMA WC 71/ICEA S-96-659 ASTM B857 for cross-linked polyethylene insulation.

2.8 NOT USED

2.9 NOT USED

2.10 ANCHORS AND ANCHOR RODS

Anchors must present holding area indicated on drawings as a minimum. Anchor rods must be triple thimble-eye, 3/4 inch diameter by 8 feet long. Anchors and anchor rods must be hot dip galvanized.

2.10.1 Screw Anchors

Screw type swamp anchors having a manufacturer's rating and extra heavy pipe rods conforming to ASTM A53/A53M, Schedule 80, and couplings conforming to ASME B16.11,

2.11 NOT USED

2.12 NOT USED

2.13 NOT USED

2.14 CONDUIT RISERS AND CONDUCTORS

The riser shield must be PVC containing a PVC back plate and PVC extension shield or a rigid galvanized steel conduit, as indicated, and conforming to UL 6. Provide conductors and terminations as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.15 NOT USED

2.16 GROUP-OPERATED LOAD INTERRUPTER SWITCHES

2.16.1 Manually Operated Type (Switch Handle Operated)

Manually operated (switch handle operated) load interrupter switches must comply with IEEE C37.30.1 and must be of the outdoor, manually-operated, three-pole, single-throw type with either tilting or rotating insulators. Switches must be equipped with interrupters capable of interrupting currents equal to the switch's continuous current rating. Each switch must be preassembled for the indicated configuration and mounting. Moving contacts must be of the high-pressure, limited-area type, designed to ensure continuous surface contact. Switches must be fused or non-fused as indicated. Switches must be complete with necessary operating mechanisms, handles, and other items required for manual operation from the ground. Switch operating handles must be located approximately 3 feet 6 inches above final grade. Insulation of switch operating mechanisms must include both insulated interphase rod sections and insulated vertical shafts. Provide each handle must be provided with a padlock arranged to lock the switch in both the open and the closed position.

2.17 NOT USED

2.18 NOT USED

2.19 NOT USED

2.20 NOT USED

2.21 NOT USED

2.22 ELECTRICAL TAPES

Tapes must be UL listed for electrical insulation and other purposes in wire and cable splices. Terminations, repairs and miscellaneous purposes, electrical tapes must comply with UL 510.

2.23 CAULKING COMPOUND

Compound for sealing of conduit risers must be of a puttylike consistency workable with hands at temperatures as low as 35 degrees F, must not slump at a temperature of 300 degrees F, and must not harden materially when exposed to air. Compound must readily caulking or adhere to clean surfaces of the materials with which it is designed to be used. Compound must have no injurious effects upon the workmen or upon the materials.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

2.24 NAMEPLATES

2.24.1 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. Equipment containing liquid-dielectrics must have the type of dielectric on the nameplate.

2.24.2 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 must identify the function and, when applicable, the position. Nameplates must be melamine plastic, 0.125 inch thick, white with black center core. Surface must be matte finish. Corners must be square. Accurately align lettering and engrave into the core. Minimum size of nameplates must be one by 2.5 inches. Lettering must be a minimum of 0.25 inch high normal block style.

2.25 NOT USED

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Hardware

Provide hardware with washer against wood and with nuts and lock nuts applied wrench tight. Provide locknuts on threaded hardware connections. Locknuts must be M-F style and not palnut style.

3.1.2 Grounding

Unless otherwise indicated, grounding must conform to IEEE C2 and NFPA 70. Pole grounding electrodes must have a resistance to ground not exceeding 25 ohms. When work in addition to that indicated or specified is directed in order to obtain specified ground resistance, provisions of the contract covering changes must apply.

3.1.2.1 Grounding Electrode Installation

Install grounding electrodes as follows:

- a. Driven rod electrodes - Unless otherwise indicated, locate ground rods approximately 3 feet out from base of the pole and drive into the earth until the tops of the rods are approximately one foot below finished grade. Evenly spaced multiple rods at least 10 feet apart and connected together 2 feet below grade with a minimum No. 6 bare copper conductor.
- b. Plate electrodes - Install plate electrodes in accordance with the manufacturer's instructions and IEEE C2 and NFPA 70.
- c. Ground resistance - The maximum resistance of a driven ground rod

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

must not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, provide additional electrodes interconnected with grounding conductors, to achieve the specified ground resistance. The additional electrodes will be a single extension-type rod, 3/4 inch diameter, up to 30 feet long, coupled and driven with the first rod. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer immediately.

3.1.2.2 Grounding Electrode Conductors

On multi-grounded circuits, as defined in IEEE C2, provide a single continuous vertical grounding electrode conductor. Bond neutrals, surge arresters, and equipment grounding conductors to this conductor. For single-grounded or ungrounded systems, provide a grounding electrode conductor for the surge arrester and equipment grounding conductors and a separate grounding electrode conductor for the secondary neutrals. Staple grounding electrode conductors to wood poles at intervals not exceeding 2 feet. On metal poles, a preformed galvanized steel strap, 5/8 inch wide by 22 gauge minimum by length, secured by a preformed locking method standard with the manufacturer, must be used to support a grounding electrode conductor installation on the pole and spaced at intervals not exceeding 5 feet with one band not more than 3 inches from each end of the vertical grounding electrode conductor. Size grounding electrode conductors as indicated. Connect secondary system neutral conductors directly to the transformer neutral bushings, then connected with a neutral bonding jumper between the transformer neutral bushing and the vertical grounding electrode conductor as indicated. Bends greater than 45 degrees in grounding electrode conductor are not permitted.

3.1.2.3 Grounding Electrode Connections

Make above grade grounding connections on pole lines by exothermic weld or by using a compression connector. Make below grade grounding connections by exothermic weld. Make exothermic welds strictly in accordance with manufacturer's written recommendations. Welds which have puffed up or which show convex surfaces indicating improper cleaning, are not acceptable. No mechanical connectors are required at exothermic weldments. Compression connectors must be type that uses a hydraulic compression tool to provide correct pressure. Provide tools and dies recommended by compression connector manufacturer. An embossing die code or similar method must provide visible indication that a connector has been fully compressed on ground wire.

3.1.2.4 Grounding and Grounded Connections

- a. Where no primary or common neutral exists, bond surge arresters and frames of equipment operating at over 750 volts together and connected to a dedicated primary grounding electrode.
- b. Where no primary or common neutral exists, bond transformer secondary neutral bushing, secondary neutral conductor, and frames of equipment operating at under 750 volts together and connected to a dedicated secondary grounding electrode.
- c. When a primary or common neutral exists, the neutral must be connected to a grounding electrode. Transformer secondary neutral bushing and frames of equipment operating at under 750 volts must be bonded

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

together and connected to a common neutral and to a common grounding electrode.

3.1.2.5 Protective Molding

Protect grounding conductors which are run on surface of wood poles by PVC molding extending from ground line throughout communication and transformer spaces.

3.1.3 CONDUCTOR INSTALLATION

3.1.3.1 Line Conductors

Unless otherwise indicated, install conductors in compliance with IEEE C2 Grade B requirements and in accordance with revised manufacturer's approved tables of sags and tensions. Handle conductors with care necessary to prevent nicking, kinking, gouging, abrasions, sharp bends, cuts, flattening, or otherwise deforming or weakening conductor or any damage to insulation or impairing its conductivity. Remove damaged sections of conductor and splice conductor. Conductors must be paid out with the free end of conductors fixed and cable reels portable, except where terrain or obstructions make this method unfeasible. Bend radius for any insulated conductor must not be less than the applicable NEMA specification recommendation. Conductors must not be drawn over rough or rocky ground, nor around sharp bends. When installed by machine power, conductors must be drawn from a mounted reel through stringing sheaves in straight lines clear of obstructions. Initial sag and tension must be checked by the Contractor, in accordance with the manufacturer's approved sag and tension charts, within an elapsed time after installation as recommended by the manufacturer.

3.1.3.2 Connectors and Splices

Conductor splices, as installed, must exceed ultimate rated strength of conductor and must be of type recommended by conductor manufacturer. No splice must be permitted within 10 feet of a support. Connectors and splices must be mechanically and electrically secure under tension and must be of the nonbolted compression type. The tensile strength of any splice must be not less than the rated breaking strength of the conductor. Splice materials, sleeves, fittings, and connectors must be noncorrosive and must not adversely affect conductors. Aluminum-composition conductors must be wire brushed and an oxide inhibitor applied before making a compression connection. Connectors which are factory-filled with an inhibitor are acceptable. Inhibitors and compression tools must be of types recommended by the connector manufacturer. Primary line apparatus taps must be by means of hot line clamps attached to compression type bail clamps (stirrups). Low-voltage connectors for copper conductors must be of the solderless pressure type. Noninsulated connectors must be smoothly taped to provide a waterproof insulation equivalent to the original insulation, when installed on insulated conductors. On overhead connections of aluminum and copper, the aluminum must be installed above the copper.

3.1.3.3 Conductor-To-Insulator Attachments

Conductors must be attached to insulators by means of clamps, shoes or tie wires, in accordance with the type of insulator. For insulators requiring conductor tie-wire attachments, tie-wire sizes must be as specified in TABLE I.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

TABLE I - TIE-WIRE REQUIREMENTS	
CONDUCTOR Copper (AWG)	TIE WIRE Soft-Drawn Copper (AWG)
6	8
4 and 2	6
1 through 3/0	4
4/0 and larger	2
AAC, AAAC, or ACSR (AWG)	AAAC OR AAC (AWG)
Any size	6 or 4

3.1.3.4 Armor Rods

Provide armor rods for AAC, AAAC, and ACSR conductors. Armor rods must be installed at supports, except armor rods will not be required at primary dead-end assemblies if aluminum or aluminum-lined zinc-coated steel clamps are used. Lengths and methods of fastening armor rods must be in accordance with the manufacturer's recommendations. For span lengths of less than 200 feet, flat aluminum armor rods may be used. Flat armor rods, not less than 0.03 by 0.25 inch must be used on No. 1 AWG AAC and AAAC and smaller conductors and on No. 5 AWG ACSR and smaller conductors. On larger sizes, flat armor rods must be not less than 0.05 by 0.30 inches. For span lengths of 200 feet or more, preformed round armor rods must be used.

3.1.3.5 Ties

Provide ties on pin insulators tight against conductor and insulator and ends turned down flat against conductor so that no wire ends project.

3.1.3.6 Low-Voltage Insulated Cables

Support low-voltage cables on clevis fittings using spool insulators. Provide dead-end clevis fittings and suspensions insulators where required for adequate strength. Dead-end construction must provide a strength exceeding the rated breaking strength of the neutral messenger. Provide clevis attachments with not less than 5/8 inch through-bolts. Secondary racks may be used when installed on wood poles and where the span length does not exceed 200 feet. Secondary racks must be two-, three-, or four-wire, complete with spool insulators. Racks must meet strength and deflection requirements for heavy-duty steel racks, and must be rounded and smooth to avoid damage to conductor insulation. Each insulator must be held in place with a 5/8 inch button-head bolt equipped with a nonferrous cotter pin, or equivalent, at the bottom. Attach racks for dead-ending four No. 4/0 AWG or four larger conductors to poles with three 5/8 inch through-bolts. Attach other secondary racks to poles with at least two 5/8 inch through-bolts. Minimum vertical spacing between conductors must not be less than 8 inches.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.1.3.7 Reinstalling Conductors

Existing conductors to be reinstalled or resagged must be strung to "final" sag table values indicated for the particular conductor type and size involved.

3.1.3.8 Aluminum Connections

Make aluminum connections to copper or other material using only splices, connectors, lugs, or fittings designed for that specific purpose. Keep a copy of manufacturer's instructions for applying these fittings at job site for use of the inspector.

3.1.4 Pole Top Switch Installation

Install pole top switch strictly according to manufacturer's installation drawings and information.

3.1.4.1 Operating Handle

Locate approximately 5 feet above ground on field side of pole.

3.1.5 Risers

Secure PVC riser shields on poles as indicated.

3.2 NOT USED

Transformers must be carefully installed so as not to scratch finishes or damage bushings. Transformers must be installed in accordance with the manufacturer's instructions. After installation, surfaces must be inspected and scratches must be touched up with a finish provided by the transformer manufacturer for this purpose.

3.3 NOT USED

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. Painting must be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5 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.

3.6 FIELD QUALITY CONTROL

3.6.1 General

Perform field testing in the presence of the Contracting Officer. The Contractor must notify the Contracting Officer days prior to conducting tests. The Contractor must furnish materials, labor, and equipment necessary to conduct field tests. The Contractor must perform tests and inspections recommended by the manufacturer unless specifically waived by

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

the Contracting Officer. The Contractor must maintain a written record of tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field reports will be signed and dated by the Contractor.

3.6.2 Safety

The Contractor must provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor must replace any devices or equipment which are damaged due to improper test procedures or handling.

3.6.3 Medium-Voltage Preassembled Cable Test

After installation, prior to connection to an existing system, and before the operating test, the medium-voltage preassembled cable system must be given a high potential test. Apply direct-current voltage on each phase conductor of the system by connecting conductors at one terminal and connecting grounds or metallic shieldings or sheaths of the cable at the other terminal for each test. Prior to the test, the cables must be isolated by opening applicable protective devices and disconnecting equipment. The method, voltage, length of time, and other characteristics of the test for initial installation must be in accordance with NEMA WC 74/ICEA S-93-639 for the particular type of cable installed, and must not exceed the recommendations of IEEE 404 for cable joints unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor must make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.6.4 Sag and Tension Test

The Contracting Officer must be given prior notice of the time schedule for stringing conductors or cables serving overhead medium-voltage circuits and reserves the right to witness the procedures used for ascertaining that initial stringing sags and tensions are in compliance with requirements for the applicable loading district and cable weight.

3.6.5 Low-Voltage Cable Test

For underground secondary or service laterals from overhead lines, the low-voltage cable, complete with splices, must be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage must be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations of conductors in the same trench, duct, or cable, with other conductors in the same trench, duct, or conduit. The minimum value of insulation must be:

$$R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 1000 / (\text{length of cable in feet})$$

Repair each cable failing this test or replace. The repaired cable must then be retested until failures have been eliminated.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.6.6 Pre-Energization Services

Perform the following services on the equipment listed below. Perform these services subsequent to testing but prior to the initial energization. Inspect the equipment to insure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Inspect terminations of conductors at major equipment to ensure the adequacy of connections. Inspect bare and insulated conductors between such terminations to detect possible damage during installation. If factory tests were not performed on completed assemblies, perform tests after the installation of completed assemblies. Inspect components for damage caused during installation or shipment and to ensure that packaging materials have been removed. Components capable of being both manually and electrically operated must be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested must be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services must be provided, but are not limited to, are the following:

Capacitors.

Switches.

3.6.7 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.6.7.1 Pole Top Interrupter Switch

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate information with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Verify appropriate equipment grounding.
- (4) Perform mechanical operator tests in accordance with manufacturer's instructions.
- (5) Verify correct blade alignment, blade penetration, travel stops, arc interrupter operation, and mechanical operation.

b. Electrical Tests

- (1) Perform insulation-resistance tests.
- (2) Perform dc over-potential tests.
- (3) Perform contact-resistance tests across each switch blade.

3.6.8 Devices Subject to Manual Operation

Each device subject to manual operation must be operated at least three times, demonstrating satisfactory operation each time.

P2# 519087 - DSSC DLA Repair Building 27
Columbus, OH

3.6.9 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor must show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function.

-- End of Section --