

**PROJECT MANUAL**

**PROJECT NO. DGS C-0946-0012 PHASE 4**

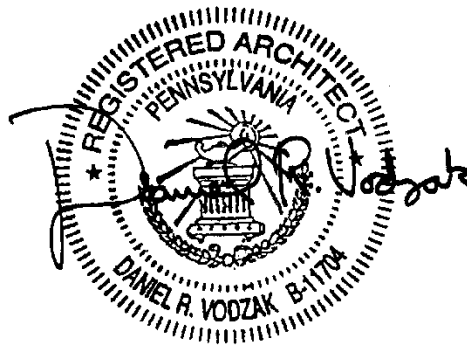
Contract No. DGS 946-12 Phase 4.1 – General Construction  
Contract No. DGS 946-12 Phase 4.2 – HVAC Construction  
Contract No. DGS 946-12 Phase 4.3 – Plumbing Construction  
Contract No. DGS 946-12 Phase 4.4 – Electrical Construction

For

**Pennsylvania State Museum and State Archives  
Renovations and Upgrades  
Harrisburg, Dauphin County, Pennsylvania**

**COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF GENERAL SERVICES  
HARRISBURG, PENNSYLVANIA**

**Governor Josh Shapiro  
Reginald B. McNeil, II, Secretary of General Services**



November 16, 2023

**VITETTA**

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## TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>
	Project Manual Cover Page
	Table of Contents
<b><u>DIVISION 01</u></b>	<b><u>GENERAL REQUIREMENTS</u></b>
Section 010100	Summary of Work
Section 010250	Unit Prices in Lump Sum Contract
Section 010300	Base Bid Descriptions
Section 010400	Coordination and Control
Section 013100	Sequence of Construction & Milestones
Section 014000	Quality Control Testing Services
Section 014010	Quality Assurance Testing and Inspection Services
Section 015000	Temporary Utilities
Section 016200	Historical and Museum Commission Projects – Supplemental Provisions
Section 016400	Capitol Complex Security Program and Contractor Requirements
Section 017100	Removal of Asbestos-Containing Materials
Section 019100	Commissioning Requirements
<b><u>DIVISION 02</u></b>	<b><u>EXISTING CONDITIONS</u></b>
Section 024119	Selective Structure Demolition
<b><u>DIVISION 03</u></b>	<b><u>CONCRETE</u></b>
Section 033053	Miscellaneous Cast-In-Place Concrete
<b><u>DIVISION 04</u></b>	<b><u>MASONRY</u></b>
Section 040140	Maintenance of Stone Assemblies
Section 040141	Cleaning of Stone Assemblies
Section 042200	Concrete Unit Masonry
<b><u>DIVISION 05</u></b>	<b><u>METALS</u></b>
Section 055000	Metal Fabrications
Section 057000	Architectural Metal Fabrications
<b><u>DIVISION 06</u></b>	<b><u>WOOD, PLASTICS, AND COMPOSITES</u></b>
Section 061053	Miscellaneous Rough Carpentry
<b><u>DIVISION 07</u></b>	<b><u>THERMAL AND MOISTURE PROTECTION</u></b>
Section 078413	Penetration Firestopping
Section 079200	Joint Sealants
<b><u>DIVISION 08</u></b>	<b><u>OPENINGS</u></b>
Section 080000	Door Schedule
Section 081113	Hollow Metal Doors and Frames
Section 083113	Access Doors and Frames
Section 084117	Flush Aluminum Doors
Section 087111	Door Hardware

**DIVISION 09**

Section 092116  
Section 092216  
Section 092300  
Section 092900  
Section 095113  
Section 096513  
Section 096519  
Section 099123  
Section 099600

**FINISHES**

Gypsum Board Shaft Assemblies  
Non-Structural Metal Framing  
Gypsum Plastering  
Gypsum Board  
Acoustical Panel Ceilings  
Resilient Base and Accessories  
Resilient Tile Flooring  
Interior Painting  
High-Performance Coatings

**DIVISION 14**

Section 142001  
Section 142003

**CONVEYING EQUIPMENT**

Electric Traction Elevator Modernization  
Electric Traction Freight Elevator Modernization

**DIVISION 21**

Section 210500  
Section 210518  
Section 210523  
Section 210529  
Section 210553  
Section 211313

**FIRE SUPPRESSION**

Common Work Results for Fire Suppression  
Escutcheons for Fire-Suppression Piping  
General-Duty Valves for Water-Based Fire-Suppression Piping  
Hangers and Supports for Fire-Suppression Piping Systems  
Identification for Fire-Suppression Piping and Equipment  
Wet-Pipe Sprinkler Systems

**DIVISION 23**

Section 230500  
Section 230513  
Section 230529  
Section 230548  
Section 230553  
Section 230593  
Section 230713  
Section 230719  
Section 230800  
Section 232300  
Section 233113  
Section 233300  
Section 233600  
Section 233713  
Section 238126

**HEATING, VENTILATING, AND AIR CONDITIONING**

Common Work Results for HVAC  
Common Motor Requirements for HVAC Equipment  
Hangers and Supports for HVAC Piping and Equipment  
Vibration Controls for HVAC  
Identification for HVAC  
Testing, Adjusting and Balancing for HVAC  
HVAC Duct Insulation  
HVAC Piping Insulation  
HVAC Systems Commissioning  
Refrigerant Piping  
Ductwork  
Air Duct Accessories  
Air Terminal Units  
Diffusers, Registers and Grilles  
Split-System Heat Pumps

**DIVISION 26**

Section 260500  
Section 260519  
Section 260526  
Section 260529  
Section 260533  
Section 260544  
Section 260553  
Section 260572

**ELECTRICAL**

Common Work Results for Electrical  
Low-Voltage Electrical Power Conductors and Cables  
Grounding and Bonding for Electrical Systems  
Hangers and Supports for Electrical Systems  
Raceways and Boxes for Electrical Systems  
Sleeves and Sleeve Seals for Electrical Raceways and Cabling  
Identification for Electrical Systems  
Overcurrent Protective Device Short-Circuit Study

**DIVISION 26**

Section 260573  
Section 260574  
Section 260800  
Section 262213  
Section 262416  
Section 262726  
Section 262813  
Section 262816  
Section 263600  
Section 265119  
Section 265219

**ELECTRICAL cont'd**

Overcurrent Protective Device Coordination Study  
Overcurrent Protective Device Arc-Flash Study  
Electrical Systems Commissioning  
Low-Voltage Distribution Transformers  
Panelboards  
Wiring Devices  
Fuses  
Enclosed Switches and Circuit Breakers  
Transfer Switches  
LED Interior Lighting  
Emergency and Exit Lighting

**DIVISION 28**

Section 281500  
Section 281603  
Section 282000  
Section 282301  
Section 283111

**ELECTRONIC SAFETY AND SECURITY**

Integrated Access Control Hardware Devices  
Security System Upgrade  
Video Surveillance  
Video Surveillance Head End Upgrade  
Digital, Addressable Fire-Alarm System

SECTION 010100  
SUMMARY OF WORK

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specification sections "General Conditions," "Special Requirements," and "General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 LOCATION

- A. State Museum and Archives of Pennsylvania, 300 North Street, Harrisburg, Dauphin County, PA.

1.3 PROJECT DESCRIPTION

- A. The project includes upgrades to the State Museum and Archives as described by this Section, other specifications and the drawings.

1.4 CONTRACT DURATION

- A. The Construction Contract duration shall be 419 calendar days commencing on the date of the Initial Job Conference.
- B. Refer to Section 013100 for how the contract duration may be impacted by long lead-time materials and equipment.

1.5 WORK INCLUDED

- A. The Work of this Project consists of, but is not limited to, the following. Detailed requirements of the Work are described in the pertinent specification Sections and/or shown on the Drawings. Below is a summarized list of the scope of work items.
  - 1. FM-1: Repair the stone failures at both the Archives and Museum.
  - 2. FM-2: Clean select areas of stone cladding at both the Archives and Museum as indicated on the drawings.
  - 3. FM-3: Repoint all stone panel joints with sealant for all buildings (Museum and Archives).
  - 4. B-2: Provide improvements to the wall separating the Archives and the Museum to achieve a two-hour fire separation.
  - 5. B-3: Provide upgrades to door hardware.
  - 6. B-4: Seal penetrations in stairs and shafts to maintain fire resistance.
  - 7. B-5: Provide rated separation between the parking garage level and the basement mechanical at equipment access.
  - 8. B-6: Adjust/repair exit doors as required for proper operation (closing force, latching, replacement of inoperable hardware, etc.).
  - 9. B-8: Develop a dedicated egress path within the garage via line striping.

10. B-9: Add exit devices (panic hardware) at designated doors where occupant loads exceed 50 persons.
11. B-10: Install a barrier at egress stair tower to prevent traveling past the level of exit discharge.
12. B-12: Provide guard rails at maintenance platforms within the ceiling plenum above Memorial Hall.
13. B-13: Provide modernization to (passenger) Elevator No. 7 and (freight) Elevator No. 8.
14. M-4: Add cooling to areas as designated on the fourth floor of the Museum.
15. M-7: Install fire/smoke dampers and detectors in shafts.
16. P-2: Relocate sprinklers where designated for compliance with current Code.
17. P-3: Replace sprinkler heads where designated in the Museum.
18. P-5: Provide isolation valves at fire risers within the Museum.
19. E-1: Provide illuminated exit signs where designated in the Museum.
20. S-1: Provide controlled access (card readers) for Pop Culture 428 on the fourth floor of the Museum.
21. S-2: Install additional CCTV cameras with motion detectors at the fourth-floor corridors of the Museum.
22. S-3/S-4: Provide addressable fire alarm system with public address throughout the Archives and Museum.
23. S-5: Provide upgrades to security panels and Video Management System (VMS).
24. S-6: Provide new fire command room.

B. GENERAL CONSTRUCTION (DGS 946-12 Phase 4.1)

1. The General Construction Contract includes construction operations traditionally recognized as general construction. It also includes administrative and coordination responsibilities for the entire project as the Lead Contractor. Work under this Prime Contract for the various project scope items includes, but is not limited to, the following:
  - a. Traffic controls required for delivery of materials to the Museum for all Prime Contractors.
  - b. Coordination and scheduling of on-site material storage areas for all Prime Contracts.
  - c. All temporary utilities assigned to this Contract.
  - d. All provisions for temporary egress adjustments to Museum, such as signage, etc.
  - e. All temporary protection of finishes as required for work of this Contract.
  - f. Hazardous abatement.
  - g. All miscellaneous concrete *except equipment pads for equipment installed by other Prime Contractors.*
  - h. Maintenance of stone assemblies, including repairs, replacement stone, select cleaning, etc.
  - i. All concrete unit masonry work.
  - j. Ladders at elevator pit.
  - k. All miscellaneous carpentry.
  - l. Firestopping *except firestopping for new conduits, pipes, etc., installed by other Prime Contractors.*
  - m. All joint sealants.
  - n. Hollow metal doors and frames.
  - o. Flush aluminum doors.
  - p. Access doors and frames.
  - q. Overhead coiling grilles.
  - r. Door hardware.
  - s. Gypsum board for shaft assemblies.
  - t. Non-structural metal framing.

- u. Gypsum plaster.
- v. Gypsum board.
- w. Acoustical ceilings.
- x. Interior painting.

C. HVAC CONSTRUCTION (DGS 946-12 Phase 4.2)

1. The HVAC Construction Contract includes construction operations traditionally recognized as HVAC and mechanical construction. It also includes administrative and coordination responsibilities for work of this Contract. Work under this Prime Contract for the various project scope items includes, but is not limited to, the following:
  - a. All temporary utilities assigned to this Contract.
  - b. All temporary protection of finishes as required for work under this Contract.
  - c. All basic materials and methods required for work under this Contract.
  - d. All concrete pads for equipment installed under this Contract.
  - e. General duty valves for HVAC piping.
  - f. Hangers and supports for HVAC piping and equipment.
  - g. Vibration and controls for HVAC piping and equipment.
  - h. Identification of HVAC piping and equipment.
  - i. Testing, adjusting and balancing for HVAC.
  - j. HVAC duct insulation.
  - k. HVAC pipe insulation.
  - l. Hydronic piping.
  - m. Refrigerant piping.
  - n. Ductwork.
  - o. Air duct accessories.
  - p. Air terminal units.
  - q. Diffusers, registers and grilles.
  - r. Special exhaust and ventilation systems.
  - s. Split-system air conditioner heat pumps.
  - t. All access doors as required for access through walls or non-accessible ceilings for work under this Contract where access door is not included in the .1 General Contract.
  - u. All firestop sealant for pipes, conduits, etc., installed under this Contract through floor slabs and fire-rated walls.

D. PLUMBING AND FIRE PROTECTION CONSTRUCTION (DGS 946-12 Phase 4.3)

1. The Plumbing and Fire Protection Construction Contract includes construction operations traditionally recognized as plumbing and fire protection construction. It also includes administrative and coordination responsibilities for work of this Contract. Work under this Prime Contract for the various project scope items includes, but is not limited to, the following:
  - a. All basic materials and methods required for work under this Contract.
  - b. Firestop sealant for pipes, conduit, etc., installed under this contract through floors and fire-rated walls.
  - c. All access doors as required for access through walls or non-accessible ceilings for work under this Contract where access door is not included in the .1 General Contract.
  - d. Modifications to the existing wet pipe sprinkler system.
  - e. Replacement of sprinkler heads in areas indicated on the drawings.

E. ELECTRICAL CONSTRUCTION (DGS 946-12 Phase 4.4)

1. The Electrical Construction Contract includes construction operations traditionally recognized as electrical construction for items such as power, lighting, communications and special systems. It also includes administrative and coordination responsibilities for work of this Contract. Work under this Prime Contract for the various project scope items includes, but is not limited to, the following:
  - a. All concrete pads for equipment installed under this Contract.
  - b. All firestop sealant for penetrations through floor slabs and fire-rated walls for piping and conduit installed under this Contract.
  - c. All access doors as required for access through walls or non-accessible ceilings for work under this Contract where access door is not included in the .1 General Contract.
  - d. Low-voltage electrical power, conductors and cables.
  - e. Grounding and bonding of electrical system.
  - f. Hangers and supports for electrical systems.
  - g. Raceways and boxes for electrical systems.
  - h. Sleeves and sleeve seals for electrical raceways and cabling.
  - i. Identification of electrical systems.
  - j. Overcurrent protective device short-circuit and coordination studies.
  - k. Overcurrent protective device arc flash study.
  - l. Electrical power and monitoring control.
  - m. Low-voltage distribution transformers.
  - n. Switchboards.
  - o. Panelboards.
  - p. Wiring devices.
  - q. Enclosed switches and circuit breakers.
  - r. Variable frequency motor controls.
  - s. Transfer switches.
  - t. LED interior lighting.
  - u. Emergency and exit lighting.
  - v. Digital addressable fire alarm system.
  - w. Fire alarm systems: Engage Siemens to provide the fire alarm/detection system devices, panels, terminations and all programming in accordance with the drawings and specifications. The .4 Electrical Contractor shall carry a cost of \$720,000.00 in their overall bid for Siemens scope of work. The Siemens account executive, Rohan Beasley, can be contacted at (717) 791-4323 [rohan.beasley@siemens.com](mailto:rohan.beasley@siemens.com). The Siemens Smart Infrastructure Branch Office is the exclusive provider of the Siemens Desigo Branded Modular and Compact fire alarm systems within Dauphin County, Pennsylvania.
    - 1) Scope of work to be provided by Siemens:
      - a) Siemens will supply all listed equipment and perform all terminations of all devices connected to the fire alarm system. Refer to Equipment List at the end of this Section.
      - b) Siemens will provide field survey and wiring schematic for existing conditions of the Archives fire alarm system.
      - c) The .4 Electrical Contractor shall provide and install all 120VAC power, wiring, network drops, conduit, raceways, back boxes and J hooks associated with the fire alarm system and coordinate with Siemens on all installation questions and timeline expectations.
      - d) Siemens will provide all required shop drawings and submittal documents.



- e) The .4 Electrical Contractor will be responsible to provide Siemens with accurately marked-up construction drawings to enable Siemens to provide accurate as built drawings at the project completion.
- f) Siemens shall provide and test for proper for proper operation of fire alarm relay interface to air handlers and building automation systems. Shutdown responsibilities to be determined by Client Agency per provided Sequence of Operations listed below.

Fire Alarm Responsibilities Matrix:

	.4 Electrical Contractor	Siemens	Client Agency
Provide/Install 120VAC Power	X		
Provide/Install Back Boxes	X		
Provide/Install Conduit	X		
Provide/Install J Hooks/Raceways	X		
Provide/Install all Cabling	X		
Label Cabling 6" into Panel	X		
Test/Verify Cabling for Grounds, Shorts & Opens	X		
No T-Tapping Allowed	X		
Install Panels	X		
Provide/Install (3) IP Network Drops	X		
Demo Existing Panels/Devices	X		
Provide Fire Alarm Panels/Devices		X	
Terminate Panels		X	
Mount/Terminate Field Devices		X	
Connection to Desigo CC		X	
Program/Commission		X	
Testing	X		
Provide Accurate AHU Sequence of Operation			X
Provide Ethernet Connectivity to Desigo CC			X

- x. Security system, including new CCTV cameras and new card readers.
- y. Upgrades to the CCTV system video management removing the existing Bosch VMS and providing the specified new VMS.
- z. Upgrades to the security system removing the existing security panels and providing the specified new panels.
- aa. Relocating power circuits serving the card access system to a non-life safety emergency panel at the Basement Level as indicated.
  - 1) Contract drawings indicate four circuits to be relocated. The .4 Contractor shall provide labor for 2 electricians for 2 days to verify the circuits serving the card access system.
- bb. Electrical infrastructure upgrades (adding step-up transformer) to provide standby power via the existing generator for modernized Elevators E-7 and E-8.

1.6 SPECIFICATION FORMAT

- A. The Specifications for the work of the separate Prime Contracts are bound in one volume. Technical provisions which apply to each Prime Contract are included in the Divisions listed below:

- B. General Construction (4.1) Contract: Divisions 02 through 09 and 32.
- C. HVAC Construction (4.2) Contract: Division 23.
- D. Plumbing and Fire Protection Construction (4.3) Contract: Divisions 21.
- E. Electrical Construction (4.4) Contract: Divisions 26 and 28.

## 1.7 CONSTRUCTION SEQUENCE

- A. The Work shall be conducted in continuous sequences.
  - 1. The Client Agency and the public will occupy the entire Museum. The Archives has been relocated to the new location at 1601 North 6<sup>th</sup> Street; therefore, the former Archives will be mostly vacant during the construction period for this project. The .1 General Contractor shall develop a detailed and itemized schedule to minimize disruptions to the Client Agency's use of the existing facilities. The Contractors shall conduct their work to avoid disruptions to the Client Agency's occupancy and use of the Museum and Archives. The parameters for sequencing the work are as follows:
    - a. The work of all Prime Contractors shall be commenced and completed in one continuous sequence on an exhibit floor (one, two and three).
    - b. The Client Agency will permit shutting down an exhibit floor from public use for a period of up to 4 weeks, except for the following periods:
      - 1) First Floor Exhibits: Second week of March through the second week of June.
      - 2) Second and Third Floor Exhibits: Second week of March through the second week of June.
    - c. All abatement work must be completed during off hours between 6:00 p.m. and 6:00 a.m.
    - d. Work at the Basement, Ground Floor, Fourth Floor and Fifth Floor must be coordinated with the Client Agency's occupancy and operations.
    - e. All work on the fourth floor (Museum Collections) must be conducted under the observation of a Client Agency escort. All contractors must schedule work with the Client Agency a minimum of three weeks in advance.
    - f. All off hours work (between 5:00 p.m. and 7:50 a.m.) may only be conducted with a Client Agency staff member present at the Museum. All contractors must schedule work with the Client Agency a minimum of three weeks in advance.

## 1.8 WORK BY OTHERS

- A. The following DGS projects will be under construction at the same time as this project:
  - 1. DGS C-0948-0087 Phase 1 PA State Museum – Paver Repair/Replacement:
    - a. This project includes, but is not limited to, the following:
      - 1) Replacement of pavers and waterproofing at the plaza between the Museum, the PHMC Tower and the Keystone Building.
      - 2) Reconstruction of the stone clad walls around the perimeter of the plaza referenced above.
      - 3) Reconstruction/replacement of the stone cladding, soffits, etc., within the two light well courtyards of the PHMC Tower.

2. DGS C-0948-0094 Phase 1 East Wing and Main Capitol – Upgrade/Replace Emergency Generators:
  - a. This project includes, but is not limited to, the following:
    - 1) Installing a 1-megawatt standby natural gas-fired generator in Storage G-108.
3. The contractors of this project shall work with DGS BOC and the contractors of the other two projects to mutually share use of the site. No contractor shall have exclusive use of the site.

#### 1.9 E-BUILDER CONSTRUCTION MANAGEMENT SOFTWARE

- A. The electronic document repository to improve productivity and efficiency, and to streamline the process of construction management during all phases of design, procurement, award and contract administration. The Department and all Prime Contractors will utilize the e-Builder Enterprise Software Program (e-Builder) for all Work and administrative duties provided under this Contract. Any and all notifications, requests, submittals, approvals, etc., between the Department, the Prime Contractors, the Professional and/or the Construction Manager (if a CM is assigned to the Project) shall be through the e-Builder system.

#### 1.10 QUESTIONS DURING BIDDING PERIOD

- A. Direct all questions pertaining to the project to the Project Professional utilizing the e-Builder Enterprise Software Program (e-Builder) as described in the Instructions to Bidders.

#### 1.11 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  2. Specification requirements are to be performed by the contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  2. Abbreviations: Materials and products are identified by abbreviations.
  3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010100

## Equipment List

### Site

Qty	Ref #	Description
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### Museum

Qty	Ref #	Description
1	S54430-B9-A1	INCLUDES: (1) XDLC , (1)FCM2041-U2, (1) ZIC-4A, (1) CC-5, (1) PSC-12
3	S54430-B8-A1	FIELD DEVICE INTERFACE CARD
2	500-633011	LARGE SIZE (3 ROW) ENCLOSURE BACKBOX - BLACK FIELD MOUNTED
1	599-050600	INCLUDES: (1) CAB3-BD,(1) BCL AND (1) OD-LP
1	S54400-A63-A1	Dialer module (DACT)
2	500-033240	NETWORK INTERFACE CARD - H-NET,OR X-NET, AND CAN ONE CARD SLOT CC-5/CC-2
4	500-648733	REMOTE LCD DISPLAY W/ CONTROL- ACU/SIL/RESET (NO MENU CAPABILITY)FIELD MOUNTED
1	500-033270	REMOTE PRINTER MODULE (RS232,PARALLEL PRINTER PORT) FIELD MOUNTED
1	S54463-B1-A1	/NON-UL PRINTER
5	500-033040	SWITCH MODULE MOUNTS TO ID-MP
2	500-633027	INNER DOOR CONTROL MODULE MOUNTING PLATE (4 PLATES PER PACKAGE) EACH PLATE HOLDS UP TO (4) SCM-8LCM-8/BCM OR (2) FCM-6 MOUNTS TO CAB/REMBOX INNER DOORS
1	500-035200	LOCAL PAGE BOARD MOUNTS ON DAC-NET
1	500-034090	LIVE VOICE MASTER MICROPHONE INNER DOOR - 1 POSITION (MUST LEAVE SPACE BEHIND OPEN)
2	500-035600	ZONE AMP MODULE-180 WATTS (25V,70V OR 100V) CAB-MP - 1 POSITION
12	S54400-B140-A1	BOOSTER AMPLIFIER (100W, BL)
2	500-633917	ENCLOSURE FOR 100AH BATTERIES FIELD MOUNTED
2	500-633017	CAB OUTER DOOR BLANK PLATE MOUNTS TO CAB OUTER DOOR
4	500-633018	CAB OUTER DOOR GRILL PLATE MOUNTS TO CAB OUTER DOOR
6	500-633037	CARDCAGE (5 SLOTS) FOR ALL CARDS BACKBOX - 2 POSITIONS
4	500-648670	(8) NAC ZONES CODED OR NON CODED ONE CARD SLOT CC-5/CC-2
3	500-648671	2 CHANNEL ADAPTER CARD FOR ZIC-8B

5	500-033150	OUTPUT CONTROL MODULE; (16) MOUNTS TO REMBOX-MP'S OR IN CUSTOM GRAPHIC
5	500-034060	SUPERVISED INPUT MODULE; (16) SUPERVISED INPUTS (WITH 2 CONTROL RELAYS) OUTPUTS TO DRIVE LED'S OR RELAYS MOUNTS TO REMBOX-MP'S OR IN CUSTOM GRAPHIC
4	555-135860	60 PIN 6 1/2 FOOT CABLE FOR CAB2,2X AND CAB3,3X ROW TO ROW CONNECTIONS
1	S54430-B5-A1	XLS DIGITAL MESSAGE CARD
2	500-035100	DIGITAL AUDIO CARD (STAND ALONE OR MASTER SLAVE NETWORK VOICE APPLICATIONS) ONE CARD SLOT CC-5/CC-2
1	500-650127	AUDIO LEVEL CONVERSION CARD
1	500-034120	12A POWER SUPPLY EXTENDER (CONTAINS NO BATTERY CHARGER SHARES PSC-12 CHARGER) CAB-MP - 1 POSITION
1	500-633769	LARGE ENCLOSURE TRANSPONDER DOOR - BLACK MOUNTS TO CAB3-BB
12	S54339-A15-A1	Complete 6A PAD-5 Kit
24	A7F30028012	12 Volt 18 Amp Hour battery F2
24	A7F30028022	12 Volt 7 Amp Hour
4	A7F30026435	12 Volt 100 Amp Hour

## 1 E2.00B.1

Qty	Ref #	Description
2	S54322-F4-A1	Input/Output module
3	S54321-F8-A1	Address, double act MPS Isolation
1	S54370-B3-A1	SINGLE INPUT MON MOD W/ISOLATOR
9	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
15	S54320-F7-A1	Multi-Crit. Fire Det.
12	500-094151	DETECTOR BASE ASSY
3	S54319-B23-A1	Duct housing with relay
3	S54370-B7-A1	INTEL TEST SW WALL PLT & ISOLTR
3	500-649713	10 FT SAMPLING
1	500-035300	AUDIO INPUT CARD-USE TO INPUT EXTERNAL AUDIO SIGNALS INTO SYS. ONE CARD SLOT CC-5/CC-2
1	S54430-C26-A1	12A at 24VDC Pwr Supp w Charger

## 1 E2.00B.2

Qty	Ref #	Description
1	S54322-F4-A1	Input/Output module
3	S54370-B3-A1	SINGLE INPUT MON MOD W/ISOLATOR
1	S54370-B1-A1	RELAY VERSION
4	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
2	S54321-F8-A1	Address, double act MPS Isolation
1	S54329-F153-A1	Spkr Wall Wht No Stb No Ltr
4	S54320-F7-A1	Multi-Crit. Fire Det.
4	500-094151	DETECTOR BASE ASSY

## 1 E2.00G.1

Qty	Ref #	Description
7	S54329-F147-A1	Speaker Ceil Wht No Stb NoLtr
16	S54329-F164-A1	Spkr Stb Ceil Wht Clr Alt
35	S54320-F7-A1	Multi-Crit. Fire Det.
35	500-094151	DETECTOR BASE ASSY
8	S54321-F8-A1	Address, double act MPS Isolation
1	S54329-F216-A1	Strobe Wall White Clear Alert
3	S54370-B3-A1	SINGLE INPUT MON MOD W/ISOLATOR
1	S54370-B2-A1	DUAL INPUT MON MOD WITH ISOLATOR

## 1 E2.00G.2

Qty	Ref #	Description
32	S54320-F7-A1	Multi-Crit. Fire Det.
32	500-094151	DETECTOR BASE ASSY
20	S54329-F164-A1	Spkr Stb Ceil Wht Clr Alt
5	S54329-F147-A1	Speaker Ceil Wht No Stb NoLtr
3	S54321-F8-A1	Address, double act MPS Isolation

2	S54329-F216-A1	Strobe Wall White Clear Alert
1	500-636191	SET SPEAKER HI CANDELA WALL RED WEATHERPROOF
1	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt

## 1 E2.00G.3

Qty	Ref #	Description
15	S54320-F7-A1	Multi-Crit. Fire Det.
18	500-094151	DETECTOR BASE ASSY
12	S54321-F8-A1	Address, double act MPS Isolation
19	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
2	S54329-F164-A1	Spkr Stb Ceil Wht Clr Alt
4	S54320-F5-A1	Heat detector
2	S54370-B3-A1	SINGLE INPUT MON MOD W/ISOLATOR
2	S54329-F216-A1	Strobe Wall White Clear Alert
1	S54319-B23-A1	Duct housing with relay
1	S54370-B7-A1	INTEL TEST SW WALL PLT & ISOLTR
1	500-649713	10 FT SAMPLING
1	S54329-F153-A1	Spkr Wall Wht No Stb No Ltr

## 1 E2.00G.4

Qty	Ref #	Description
96	S54320-F7-A1	Multi-Crit. Fire Det.
91	500-094151	DETECTOR BASE ASSY
22	S54329-F164-A1	Spkr Stb Ceil Wht Clr Alt
10	S54321-F8-A1	Address, double act MPS Isolation
31	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
3	S54370-F12-A1	FINAL ASSEMBLY
12	S54319-B23-A1	Duct housing with relay
12	S54370-B7-A1	INTEL TEST SW WALL PLT & ISOLTR
12	500-649713	10 FT SAMPLING



9	S54370-B3-A1	SINGLE INPUT MON MOD W/ISOLATOR
8	S54329-F147-A1	Speaker Ceil Wht No Stb NoLtr
3	S54329-F216-A1	Strobe Wall White Clear Alert
10	S54320-F5-A1	Heat detector
9	S54329-F153-A1	Spkr Wall Wht No Stb No Ltr
1	500-636191	SET SPEAKER HI CANDELA WALL RED WEATHERPROOF
1	S54370-B2-A1	DUAL INPUT MON MOD WITH ISOLATOR
2	S54370-B1-A1	RELAY VERSION

## 1 E2.01

Qty	Ref #	Description
71	S54320-F7-A1	Multi-Crit. Fire Det.
56	500-094151	DETECTOR BASE ASSY
10	S54329-F147-A1	Speaker Ceil Wht No Stb NoLtr
13	S54329-F164-A1	Spkr Stb Ceil Wht Clr Alt
5	S54370-F12-A1	FINAL ASSEMBLY
10	S54319-B23-A1	Duct housing with relay
10	S54370-B7-A1	INTEL TEST SW WALL PLT & ISOLTR
10	500-649713	10 FT SAMPLING
3	S54329-F216-A1	Strobe Wall White Clear Alert
8	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
4	S54321-F8-A1	Address, double act MPS Isolation
2	S54329-F153-A1	Spkr Wall Wht No Stb No Ltr
4	S54370-B1-A1	RELAY VERSION

## 1 E2.02

Qty	Ref #	Description
69	S54320-F7-A1	Multi-Crit. Fire Det.
55	500-094151	DETECTOR BASE ASSY
12	S54329-F147-A1	Speaker Ceil Wht No Stb NoLtr

14	S54329-F164-A1	Spkr Stb Ceil Wht Clr Alt
5	S54370-F12-A1	FINAL ASSEMBLY
9	S54319-B23-A1	Duct housing with relay
9	S54370-B7-A1	INTEL TEST SW WALL PLT & ISOLTR
9	500-649713	10 FT SAMPLING
1	S54329-F216-A1	Strobe Wall White Clear Alert
4	S54321-F8-A1	Address, double act MPS Isolation
10	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
2	S54370-B1-A1	RELAY VERSION

## 1 E2.03

Qty	Ref #	Description
84	S54320-F7-A1	Multi-Crit. Fire Det.
69	500-094151	DETECTOR BASE ASSY
11	S54329-F147-A1	Speaker Ceil Wht No Stb NoLtr
16	S54329-F164-A1	Spkr Stb Ceil Wht Clr Alt
4	S54370-F12-A1	FINAL ASSEMBLY
11	S54319-B23-A1	Duct housing with relay
11	S54370-B7-A1	INTEL TEST SW WALL PLT & ISOLTR
11	500-649713	10 FT SAMPLING
4	S54321-F8-A1	Address, double act MPS Isolation
8	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
5	S54370-B1-A1	RELAY VERSION

## 1 E2.04

Qty	Ref #	Description
91	S54320-F7-A1	Multi-Crit. Fire Det.
85	500-094151	DETECTOR BASE ASSY
48	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
5	S54370-F12-A1	FINAL ASSEMBLY

4	S54320-F5-A1	Heat detector
5	S54319-B23-A1	Duct housing with relay
5	S54370-B7-A1	INTEL TEST SW WALL PLT & ISOLTR
5	500-649713	10 FT SAMPLING
4	S54321-F8-A1	Address, double act MPS Isolation
2	S54370-B3-A1	SINGLE INPUT MON MOD W/ISOLATOR
2	S54370-B1-A1	RELAY VERSION

## 1 E2.05

Qty	Ref #	Description
57	S54320-F7-A1	Multi-Crit. Fire Det.
53	500-094151	DETECTOR BASE ASSY
6	S54370-F12-A1	FINAL ASSEMBLY
3	S54329-F153-A1	Spkr Wall Wht No Stb No Ltr
9	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
13	S54329-F164-A1	Spkr Stb Ceil Wht Clr Alt
2	S54320-F5-A1	Heat detector
2	S54329-F147-A1	Speaker Ceil Wht No Stb NoLtr
4	S54321-F8-A1	Address, double act MPS Isolation
2	S54370-B1-A1	RELAY VERSION

## 1 E2.06

Qty	Ref #	Description
8	S54320-F5-A1	Heat detector
11	500-094151	DETECTOR BASE ASSY
8	S54370-B3-A1	SINGLE INPUT MON MOD W/ISOLATOR
7	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
2	500-636191	SET SPEAKER HI CANDELA WALL RED WEATHERPROOF
3	S54320-F7-A1	Multi-Crit. Fire Det.
1	S54321-F8-A1	Address, double act MPS Isolation

1	500-698218	MET MFS-KEY-DBACT WP
1	S54370-B4-A1	MINI INPUT MON MOD,BLT-IN ISOLTR

## MOSA Panel

Qty	Ref #	Description
1	S54465-C62-A1	MOSA MONITORING ONLY SOLUTION ASSEMBLY

## Archive Tower

Qty	Ref #	Description
1	S54430-B8-A1	FIELD DEVICE INTERFACE CARD
1	500-633011	LARGE SIZE (3 ROW) ENCLOSURE BACKBOX - BLACK FIELD MOUNTED
1	500-033240	NETWORK INTERFACE CARD - H-NET,OR X-NET, AND CAN ONE CARD SLOT CC-5/CC-2
2	500-035600	ZONE AMP MODULE-180 WATTS (25V,70V OR 100V) CAB-MP - 1 POSITION
1	500-633917	ENCLOSURE FOR 100AH BATTERIES FIELD MOUNTED
3	500-633018	CAB OUTER DOOR GRILL PLATE MOUNTS TO CAB OUTER DOOR
3	500-633037	CARDCAGE (5 SLOTS) FOR ALL CARDS BACKBOX - 2 POSITIONS
6	500-648670	(8) NAC ZONES CODED OR NON CODED ONE CARD SLOT CC-5/CC-2
3	500-648671	2 CHANNEL ADAPTER CARD FOR ZIC-8B
2	555-135860	60 PIN 6 1/2 FOOT CABLE FOR CAB2,2X AND CAB3,3X ROW TO ROW CONNECTIONS
1	500-035100	DIGITAL AUDIO CARD (STAND ALONE OR MASTER SLAVE NETWORK VOICE APPLICATIONS) ONE CARD SLOT CC-5/CC-2
1	500-034120	12A POWER SUPPLY EXTENDER (CONTAINS NO BATTERY CHARGER SHARES PSC-12 CHARGER) CAB-MP - 1 POSITION
1	500-633769	LARGE ENCLOSURE TRANSPONDER DOOR - BLACK MOUNTS TO CAB3-BB
2	A7F30026435	12 Volt 100 Amp Hour

## 1 E2.00B.2

Qty	Ref #	Description
1	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt

## 1 E2.07

Qty	Ref #	Description
35	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
33	S54329-F153-A1	Spkr Wall Wht No Stb No Ltr
15	S54329-F216-A1	Strobe Wall White Clear Alert

## **1 E2.08**

Qty	Ref #	Description
5	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
4	S54329-F153-A1	Spkr Wall Wht No Stb No Ltr

## **Desigo CC**

Qty	Ref #	Description
1	P55802-Y110-A100	CCA-CMPT-DMS Compact Server License
1	P55802-Y127-A300	CCA-OP-GRAPH-ED CC opt graphic ed
2	P55802-Y158-A452	CCA-500-FIRE Add 500 Fire Points

## **Spare Material**

Qty	Ref #	Description
69	S54320-F7-A1	Multi-Crit. Fire Det.
13	500-094151	DETECTOR BASE ASSY
1	S54370-F12-A1	FINAL ASSEMBLY
1	S54329-F147-A1	Speaker Ceil Wht No Stb NoLtr
1	S54329-F153-A1	Spkr Wall Wht No Stb No Ltr
1	S54329-F177-A1	Spkr Stb Wall Wht Clr Alt
1	S54329-F164-A1	Spkr Stb Ceil Wht Clr Alt
1	S54329-F216-A1	Strobe Wall White Clear Alert
1	500-636191	SET SPEAKER HI CANDELA WALL RED WEATHERPROOF

SECTION 010250  
UNIT PRICES IN LUMP SUM CONTRACTS

PART 1 – GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DEFINITIONS

- A. Unit Price: An amount bid by the Contractor for a unit quantity of a work item listed in the Schedule of Unit Prices.
- B. Schedule of Unit Prices: The schedule of work items in the Contract for which the Contractor is to provide a price for adjusting the Contract amount for changes in quantity of work required.

1.3 PROCEDURES

- A. Unit Prices will be used as the basis for computing "additions to" or "deductions from" the Lump Sum Contract amount for extra work and for reductions in quantities of work called for by the Contract Documents. The unit price applied for "Adds" to the bid quantity will be equal to the unit price applied for "Deducts" to the bid quantity for each item listed. Unit Prices shall remain binding and irrevocable for the entire period of the Contract.
- B. Unit Prices shall include all costs by the Contractor, his suppliers and subcontractors for the work, including labor, material, tools, equipment, insurance, taxes, field overhead, general overhead and profit and bond. The work shall include all incidental items required to complete the work.
- C. The Department will not be bound by the Unit Prices unless it accepts the same by indication on the Construction Contract. The Department may award the contract without accepting the bidder's Unit Prices. If the Department and the Contractor are unable to agree upon a new Unit Price, the Department may at its discretion, direct the Contractor to perform such work on a force account basis.
- D. Work added to the Contract will be of the same general character as that required by the Contract Documents. Contractors are to assume that changes will be made in a timely manner, not requiring the Contractor to incur additional mobilization or other disproportional expenses in connection with the adjustment in contract quantities.
- E. Each bidder shall carefully check the drawings and specifications for the Base Bid quantities required to be included under the Contract.
- F. Contractors are to comply with requirements of the Instructions to Bidders and instructions for completion of the Bid Form.

#### 1.4 SCHEDULE OF UNIT PRICES

- A. The following Schedules of Unit Prices apply to the Contracts indicated on the Schedules. The Contractor is to provide Unit Prices for all items.

GENERAL CONSTRUCTION (.1) CONTRACT – SCHEDULE OF UNIT PRICES									
				QUANTITIES					
UNIT PRICE NO.	DESCRIPTION	CODE	UNIT OF MEASURE	ARCHIVES	MUSEUM	TOTAL	BASE BID 1	BASE BID 2	BASE BID 3
1	Dutchman Repair	DMR	Square Inch	437	1,029	1,466	1,466	1,466	1,466
2	Crack Repair	CR	Linear Inch	850	4,709	5,559	5,559	5,559	5,559
3	Mortar Patch	MP	Square Inch	1,597	2,770	4,367	4,367	4,367	4,367
4	Spall Repair	SP	Square Inch	1,031	1,201	2,232	2,232	2,232	2,232
5	Spall Repair/Mortar Patch	SP/MP	Square Inch	170	223	393	393	393	393
6	Laser Cleaning of Limestone Panels Surfaces	CLS & CPH	Square Feet			28,311	0	0	28,311
7	Laser Cleaning of Limestone Panel Returns	CPR	Square Feet			800	0	0	800

#### 1.5 CHANGES

- A. All changes in the quantity of work for which there is a Unit Price will be authorized using change order procedures provided in the General Conditions. Change Orders shall be written prior to performing the work where possible but may be written after the work is authorized, completed and measured when quantities are not able to be determined in advance.

#### 1.6 MEASUREMENT

- A. Measurement of the work quantities where the work is performed prior to issuance of a Change Order shall be net quantities and not include cutting waste, or other adjustments to the unit of measure of the Unit Price. The Department and Contractor shall arrive at a rational procedure for measurement prior to performing the work. The Contractor shall be responsible for measurement and will submit the calculations and worksheets to the Department for approval.

1.7 DESCRIPTIONS OF UNIT PRICES

A. General Construction (.1) Contract:

1. Unit Price 1: Dutchman repair of limestone (DMR).
2. Unit Price 2: Crack repair of limestone (CR).
3. Unit Price 3: Mortar repair of limestone (MR).
4. Unit Price 4: Spall repair of limestone (SP).
5. Unit Price 5: Spall repair/mortar patch (SP/MP).
6. Unit Price 5: Laser cleaning of stone panel surfaces (CLS & CPH).
7. Unit Price 6: Laser cleaning of stone panel returns (CPR).

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 010250



SECTION 010300

BASE BID DESCRIPTIONS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specification sections "General Conditions," "Special Requirements," and "General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

- A. This Section includes the identification of each Base Bid and description of the changes to be associated with each Base Bid.

- 1. Base Bid amounts are to be cumulative. For instance, Base Bid 2 shall include all work in Base Bid 1 plus the work added in Base Bid 2.

- a. Example:

Value of Work described in Base Bid 1:	\$100.00
<u>Value of Work described to be added by Base Bid 2:</u>	<u>\$157.00</u>
Base Bid 2 Amount:	\$257.00

1.3 DESCRIPTION OF SEPARATE BASE BIDS

- A. GENERAL CONSTRUCTION CONTRACT (DGS 946-12 PHASE 4.1)

- 1. Base Bid No. 1:

- a. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications for the scope items listed below, except that work specifically called out as being part of another Base Bid.

- 1) FM-1: Repair the stone failures at both the Archives and Museum.
- 2) B-2: Provide improvements to wall separating the Archives and the Museum to achieve a one-hour fire separation.
- 3) B-3: Provide upgrades to door hardware.
- 4) B-4: Seal penetrations in stairs and shafts to maintain fire resistance.
- 5) B-5: Provide fire separation between parking garage and basement mechanical room.
- 6) B-6: Adjust/repair exit doors as required for proper operation (closing force, latching, replacement of inoperable hardware, etc.).
- 7) B-8: Develop dedicated egress path within the parking garage.
- 8) B-9: Add exit devices (panic hardware) at designated doors.
- 9) B-10: Install gate in Stair 4.
- 10) B-12: Provide guards at maintenance platforms within the ceiling plenum above Memorial Hall.

- 11) B-13: Provide modernization to (passenger) Elevator No. 7 and (freight) Elevator No. 8.
- 12) General construction supportive work for the following work being performed by other prime contractors.
  - a) M-4: Add cooling to areas as designated on the 4<sup>th</sup> floor of the Museum.
  - b) M-7: Install fire/smoke dampers in shafts.
  - c) S-6: Provide new fire command room.

2. Base Bid No. 2:

- a. Same as Base Bid No. 1 except add the following scope items:

- 1) FM-3: Repoint all stone panel joints with sealant for all buildings (Museum and Archives).

3. Base Bid No. 3:

- a. Same as Base Bid No. 2 except add the following scope items:

- 1) FM-2: Select cleaning of stone cladding at both the Archives and Museum.

B. HVAC CONSTRUCTION CONTRACT (DGS 946-12 PHASE 4.2)

1. Base Bid No. 1:

- a. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications for the scope items listed below, except that work specifically called out as being part of another Base Bid.

- 1) B-2: Provide fire dampers at rated wall separating the Museum and the former Archives.
- 2) M-4: Add cooling to areas as designated on the 4<sup>th</sup> floor of the Museum.
- 3) M-7: Install fire/smoke dampers and detectors in shafts.
- 4) S-6: Provide new fire command room.

2. Base Bid No. 2:

- a. Same as Base Bid No. 1; no additional work.

3. Base Bid No. 3:

- a. Same as Base Bid No. 2; no additional work.

C. PLUMBING AND FIRE PROTECTION CONTRACT (DGS 946-12 PHASE 4.3)

1. Base Bid No. 1:

- a. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications for the scope items listed below, except that work specifically called out as being part of another Base Bid.

- 1) P-2: Relocate sprinklers where designated.
    - 2) P-3: Replace sprinkler heads where designated throughout Archives and Museum.
    - 3) P-5: Provide isolation valves at fire risers.
  2. Base Bid No. 2:
    - a. Same as Base Bid No. 1; no additional work.
  3. Base Bid No. 3:
    - a. Same as Base Bid No. 2; no additional work.
- D. ELECTRICAL CONSTRUCTION CONTRACT (DGS 946-12 PHASE 4.4)
  1. Base Bid No. 1:
    - a. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications for the scope items listed below, except that work specifically called out as being part of another Base Bid.
      - 1) E-1: Provide illuminated exit signs where designated throughout the Museum.
      - 2) Electrical supportive work for the following:
        - a) B-13: Provide modernization to (passenger) Elevator No. 7 and (freight) Elevator No. 8.
        - b) M-4: Add cooling to areas as designated on the 4<sup>th</sup> floor of the Museum.
        - c) M-7: Install fire/smoke dampers and detectors in shafts M-8: Provide pressurization of stair towers.
        - d) P-5 Provide isolation valves at fire risers.
      - 3) S-1: Provide upgrades to the security system on the 4<sup>th</sup> floor of the Museum.
      - 4) S-2: Install additional CCTV cameras at the 4<sup>th</sup> floor corridors of the Museum.
      - 5) S-3/S-4: Provide addressable fire alarm system throughout the Archives and Museum.
      - 6) S-5: Provide upgrades to security panels and video management.
      - 7) S-6: Provide new fire command room.
  2. Base Bid No. 2:
    - a. Same as Base Bid No. 1; no additional work.
  3. Base Bid No. 3:
    - a. Same as Base Bid No. 2; no additional work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010300

## SECTION 010400

### COORDINATION AND CONTROL

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions," "Special Requirements," and "General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SECTION INCLUDES

- A. This Section includes the on-site provisions that govern the performance of the work to complete this Project.

##### 1.3 CONTRACTS – FOR THIS PROJECT CONSTRUCTION

- A. GENERAL CONSTRUCTION CONTRACT (DGS 946-12 PHASE 4.1)
  - 1. The 4.1 General Contractor shall be the Lead Contractor.
- B. HVAC CONSTRUCTION CONTRACT (DGS 946-12 PHASE 4.2)
- C. PLUMBING AND FIRE PROTECTION CONTRACT (DGS 946-12 PHASE 4.3)
- D. ELECTRICAL CONSTRUCTION CONTRACT (DGS 946-12 PHASE 4.4)

##### 1.4 VISIT TO SITE

- A. For access to the site during the bidding period contact the Client Agency site personnel with phone number listed below:
  - 1. Client Agency Site Representative: Roger Ciecierski, Facilities Operation Manager, Pennsylvania Historic and Museum Commission.
  - 2. Telephone Number: (717) 525-5368.
  - 3. Email: [rcieciersk@pa.gov](mailto:rcieciersk@pa.gov)

##### 1.5 UNIDENTIFIED HAZARDOUS MATERIALS (ASBESTOS, CHEMICALS, ETC.)

- A. Areas of asbestos abatement are identified in Specification Sections 017100 Removal of Asbestos-Containing Materials. Abatement of hazardous materials is included in the scope of work for the .1 General Contractor.

- B. There is a possibility that additional hazardous materials, not identified in the contract documents, may be discovered on this project. Should it be determined that some or all of the hazardous materials must be removed, the Department and respective Contractor shall notify the .1 General Contractor. The .1 General Contractor shall obtain an estimate for said removal from a subcontractor experienced in the field, who has insurance and is knowledgeable of the regulations as they apply. The .1 General Contractor may provide the estimate if qualified in the applicable hazardous materials field. The Department shall consider authorizing a Change Order for the removal of the hazardous material to the extent necessary.
- C. The Contractor or Subcontractor must comply with all requirements of the General Conditions, including the maintenance of insurance up to the limit required under the General Conditions.
- D. Should a hazardous material be encountered on the job, the Contractor shall comply with all statutes and regulations of the Commonwealth of Pennsylvania and all rules and regulations of the United States Environmental Protection Agency as they apply during construction and demolition work and the disposal of hazardous material. Particular attention is drawn to Code of Federal Regulations, Title 40, Part 61, Section 112 of Clean Air Act and PA Department of Labor and Industry, Act 194 for asbestos.
- E. The Contractor shall comply fully with the regulations of OSHA as they pertain to the protection of workers exposed to the emission of asbestos fibers, chemicals, etc., and shall take all steps necessary to protect its employees, as well as all other people engaged in the building.
- F. Whenever a hazardous material is to be removed or disposed of, the Contractor is required to make proper notification to the Bureau of Air Quality Control in the Department of Environmental Protection's Regional Office, PA Department of Labor and Industry and EPA as applicable, and is required to obtain and pay for any permits required. Disposal shall conform to all applicable regulations and documentation shall be required, when applicable.

#### 1.6 LEAD PAINT

- A. All work is to be performed with the assumption that all painted surfaces are lead containing. Each Prime Contractor is responsible for following all required OSHA 1926.62 'Lead In Construction' standards when disturbing or impacting these painted surfaces during the course of the renovations, including but not limited to activities such as: cutting and patching, core drilling, penetration, anchoring, fastening, etc. The area(s) shall be visually clean upon completion of any of these activities.
  - 1. Action Plan: Contractor(s) shall submit an Action Plan that conforms to Paragraph 1.6.A.1-3 herein for approval at the Initial Job Conference, which specifically outlines details of means and methods to be used for each dust-generating activity involving lead-painted surfaces, erection of critical barriers and plastic sheeting for dust control, subsequent exposure assessment, personal protective equipment, hygiene and clean-up.
  - 2. Contractor(s) shall utilize means and methods that preclude dust generation to complete work that disturbs/impacts lead-containing paint (i.e., paint stripper, HEPA-assisted drills, etc.).
  - 3. Contractor(s) shall ensure areas beyond work area are not contaminated and shall immediately stop work and erect plastic sheeting to prevent the spread of dust, anytime means and methods inadvertently create dust.

## 1.7 MOLD

- A. In the event mold is encountered, the Contactor shall implement corrective actions to protect workers, other building occupants, and to prevent the disturbance of mold in affected areas. Although not presently regulated by EPA and/or OSHA, the EPA does provide industry standards regarding worker safety and abatement procedures, which are the minimum procedures to be followed if mold is encountered.
- B. Any mold that appears as a result of construction shall be abated immediately by the Contractor responsible for this condition. The affected surface shall be cleaned, removed, and replaced. Inspection and testing shall be done by a qualified testing agency to confirm the mold has been removed in its entirety.
  - 1. Action Plan must be reviewed and approved by Department and Client Agency.

## 1.8 TESTING OF EQUIPMENT

- A. After any equipment furnished under the contract and any permanent heating, ventilating, plumbing, drainage or electrical systems and equipment have been installed or modified, it shall be the responsibility of the Contractor to operate its equipment for a satisfactory period of time, as required by the Department for proper testing and instructing the operating personnel. Fuel, electricity and water required for proper testing of permanent equipment and for the period of instructing personnel, shall be paid for by the Contractor testing its equipment.

## 1.9 PROJECT PHOTOGRAPHS

- A. The .1 General Contractor shall provide photographs of the progress of each scope item through the entire construction process.
- B. Refer to Section 016200 "Historical and Museum Commission Projects – Supplemental Provisions."

## 1.10 INSTRUCTIONS AND TRAINING

- A. Refer to the General Conditions of the Construction Contract, as specified in the applicable technical portion of each specification for "Operations and Maintenance Instruction Manuals" and "Record Drawings" requirements.
- B. Unless approved by the Department, training shall not be scheduled/conducted until Record Drawings, Operation and Maintenance Instruction Manuals, valve tag lists, equipment and piping system identification, and all software programming is complete.
- C. Provide full on-site training and instruction to designated Commonwealth personnel given by competent manufacturer's authorized personnel thoroughly familiar with all technical and operational aspects of the installed items. Instructions are to cover operation and maintenance of all systems, equipment components and other items as specified and furnished under this Contract. Instructional digital video recordings may be used to augment required instructions and training but may not be substituted for the in-person on-site training. All on-site training shall be digitally recorded by the Contractor. The digital video files are to be turned over to the Client Agency.

- D. Contractor shall provide an outline of the training and course content, which shall be submitted and accepted by the Professional and Department prior to conducting training.
- E. Conduct instruction and training during regular working hours. For training on complicated systems, allow at least one-half of the training time to be at and/or with the system equipment.
- F. Provide additional training and instructions for all significant modifications and/or changes made under the terms and/or conditions of the manufacturer's and/or Contractor's warranty.
- G. The Contractor shall maintain and submit a sign-in list that clearly documents all personnel attending the training.

1.11 PROJECT SIGN

- A. Provide a project sign. Refer to the General Conditions of the Construction Contract.

1.12 REUSE OF MATERIALS

- A. No removed materials or equipment shall be reinstalled in the work, unless so noted on the Drawing or in these Specifications below.

1.13 WORKING HOURS

- A. The Contractor's available working hours shall be 7:30 a.m. to 5:00 p.m., Monday through Friday.

- 1. PHMC Maintenance staff must be present within the Museum/PHMC Tower at all times when contractors are on site and working.
- 2. A PHMC escort is required for all work on the 4<sup>th</sup> floor of the Museum.

- B. Work during different hours, or work on Saturdays, Sundays, State and National Holidays or overtime work, must have prior written approval from the Client Agency and the Regional Director or his designee. Work on these days, if approved, shall be at no additional cost or time to the Contract.

- 1. Commonwealth of Pennsylvania State Holidays – 2024 (subject to verification at time of Commonwealth official posting):

a.	Monday	January 1	New Year's Day
b.	Monday	January 15	Martin Luther King Day
c.	Monday	February 19	Presidents' Day
d.	Monday	May 27	Memorial Day
e.	Wednesday	June 19	Juneteenth
f.	Thursday	July 4	Independence Day
g.	Monday	September 2	Labor Day
h.	Monday	October 14	Columbus Day
i.	Monday	November 11	Veterans Day
j.	Thursday	November 28	Thanksgiving
k.	Friday	November 29	Thanksgiving Friday
l.	Wednesday	December 25	Christmas Day

2. Commonwealth of Pennsylvania State Holidays – 2025 (subject to verification at time of Commonwealth official posting):

a.	Wednesday	January 1	New Year's Day
b.	Monday	January 20	Martin Luther King Day
c.	Monday	February 17	Presidents' Day
d.	Monday	May 26	Memorial Day
e.	Thursday	June 19	Juneteenth
f.	Friday	July 4	Independence Day
g.	Monday	September 1	Labor Day
h.	Monday	October 13	Columbus Day
i.	Tuesday	November 11	Veterans Day
j.	Thursday	November 27	Thanksgiving
k.	Friday	November 28	Thanksgiving Friday
l.	Thursday	December 25	Christmas Day

- C. This shall not apply in those unforeseen isolated and/or emergency instances when a particular operation must be performed in a continuous sequence that extends the working day beyond the approved working hours. Coordinate with the Department in these instances.
- D. The Department's failure to approve different working hours, weekend or holiday working hours, or overtime hours is not cause for a claim against the Department for delay or any added costs or time to the Contract.
- E. Utility shutdowns are not anticipated for this project. Utility shutdowns shall be coordinated two weeks in advance with the Client Agency to minimize disruption to the operation of the Museum and/or Archives.

1.14 NO WORK EVENTS

- A. Contractor shall be advised that no work shall be permitted within the Museum on the following dates (event to be blacked out annually throughout the project duration):
  - 1. Noon Years Eve Event (daytime, children):
    - a. Friday, December 27, 2024 *or*
    - b. Monday, December 30, 2024
  - 2. PA Museums Conference (access public areas, exhibits):
    - a. Monday-Tuesday, April 15-16, 2024

1.15 WORK AROUND EVENTS

- A. All contractors are advised that there will be events, as listed below, during which the contractors must coordinate and schedule their work to minimize disruptions to these events.
  - 1. **School Group Tours: School Tour Season is March 1 to June 16 every year.**
    - a. Impacts: Ground, First, Second and Third Floors.
    - b. Uses North Street entry primarily, closest to bus lane.
    - c. Most students are between 8 and 11 years of age.
    - d. Daily visitation can be several hundred students.



- e. Coordinate all work with Client Agency, to be contained within agreed upon areas.
  - f. Work containment, particularly as may be required in any area containing hazardous materials, will be subject to increased scrutiny and review.
  - g. Client Agency acknowledges that not all exhibits or areas within the Museum will be available for all School Group Tours throughout the work.
  - h. Client Agency will work with the contractors to develop mutually acceptable safe paths of travel for tours and labor.
  - i. Client Agency will share advance schedule for School Group Tours.
  - j. Client Agency will share a daily "School Group Tour" schedule confirmation/update to alert project team to last minute changes to visitation counts, periods of congestion.
2. Other Events (auditorium and adjacent lobby, restrooms, may include refreshments in Susquehanna Room; may use North Street entry):
- a. PA History 101 Presentations (Auditorium, 4-hour block, event is recorded for distribution):
    - 1) Tuesday, March 5, 2024
    - 2) Tuesday, May 21, 2024
    - 3) Tuesday, June 4, 2024 or June 11, 2024
    - 4) Tuesday, September 10, 17 or 24, 2024
  - b. Receptions: Student Nurses Event (Auditorium, 2-hours):
    - 1) Tuesday, March 19, 2024
    - 2) Tuesday, March 25, 2024
  - c. Conferences – Workshops: Archaeology Workshop on Third Floor:
    - 1) Friday-Saturday, October 25-26, 2024 (all day)

#### 1.16 DELIVERY, STORAGE AND HANDLING

- A. Prefinished materials shall arrive at job site in their original unopened cartons or other protective packaging necessary to protect finishes. Materials should be stored in such packages until time of application. Flat materials, such as panels, shall arrive and remain on adequate support to ensure flatness and prevent damage.
- B. Store all materials, equipment and bulk items prior to installation in clean, dry, well-ventilated locations. Waterproof tarpaulin or polyethylene sheeting must allow for air circulation under covering.
- C. Storage locations for materials on site is limited as stipulated in this Section and on the drawing. Storage shall be coordinated with the Department and approved by the Client Agency.
  - 1. All Prime Contractors shall mutually share the material storage areas.
  - 2. The .1 General Contractor shall be responsible to coordinate and schedule the use of the storage areas among itself and the other 3 Prime Contractors.
- D. The Client Agency will permit use of their loading at the ground floor level, which is accessible from North Street. Deliveries to the loading dock shall be scheduled and coordinated with the Client Agency and Department 3 business days in advance of the scheduled delivery.

- E. The Client Agency will permit the use of the existing freight elevator for transporting construction materials up through the Museum. All Prime Contractors shall mutually cooperate with one another and share the use of the freight elevator.
  - 1. All uses of the freight elevator extending more than 1 hour shall be scheduled and coordinated with the Client Agency and Department 3 business days in advance.
- F. There shall be no construction use of passenger Elevator No. 7 within the Museum.
- G. There shall be no construction use of the escalators within the Museum.
- H. Elevator access within the Archives (PHMC Tower) is limited to the two passenger elevators. There are no restrictions on the use of these elevators.

#### 1.17 PARKING

- A. The Client Agency will permit parking of one service-type, pick-up size vehicle within its parking garage during the construction for the .1 General Construction Contractor only.
- B. The Client Agency will permit on-site parking at the northwest corner of the site as indicated on Drawing G201.
  - 1. The use of this on-site parking area is not mandated and is at the option of the .1 General Contractor.
  - 2. The .1 General Contractor shall provide all labor and materials and pay all costs associated with establishing the on-site parking area.
  - 3. The .1 General Contractor shall coordinate with the Harrisburg Parking Authority (SPM Municipal Services) for closing parking spaces along North Third Street as required to access the on-site parking area.
    - a. The cost to close a parking space is \$44 per day, six days per week.
  - 4. The .1 General Contractor may at its discretion share on-site parking with the other Prime Contractors. Other Prime Contractors shall bid the project based on no on-site parking available.
  - 5. If the on-site parking is implemented, the .1 General Contractor shall restore the on-site parking to pre-construction conditions.

#### 1.18 TRAFFIC

- A. The Lead Contractor shall establish at the Initial Job Conference a construction staging and traffic plan for the project which minimizes the construction interference with the Client Agency's operation. This plan is subject to review and acceptance by the Department, the Client Agency and Capitol Police. This acceptance does not relieve the Contractors of their responsibilities regarding safety coordination and adherence to all traffic laws and ordinances.

#### 1.19 ENVIRONMENTAL QUALITY CONTROL

- A. The Prime Contractor and its Subcontractors shall perform their work in a manner which shall minimize the possibility of air, water, land and noise pollution, in accordance with General Conditions Section 6.37.

- B. The name, address and telephone number of the Department of Environmental Protection Regional Office is furnished below. This office shall be contacted for waste disposal permits and for information concerning sites already approved for conducting waste disposal.

Southcentral Regional Office  
909 Elmerton Avenue  
Harrisburg, PA 17110-8200  
(717) 705-4700

Counties: Adams, Bedford, Berks, Blair  
Cumberland, Dauphin, Franklin, Fulton,  
Huntingdon, Juniata, Lancaster, Lebanon,  
Mifflin, Perry and York

#### 1.20 OFFICE FOR CONTRACTOR

- A. The Client Agency make vacated offices at the Ground Floor of the former Archives Tower available to the contractor as field offices. Refer to Drawing A200G.

1. Electric power at the field offices will be provided free of charge. Contractors are to use the existing 120V receptacles.
2. Telephone and data services will not be provided.
3. No provisions will be made for LAN communications to field offices. Each Prime Contractor shall be responsible for communications to its field office.
4. At the completion of the project, contractors shall restore field office areas to their pre-construction condition.

#### 1.21 DGS CONSTRUCTION COORDINATOR OFFICE

- A. The DGS Project Coordinator will utilize meeting space and equipment within the former Archives as coordinated with the Client Agency for job conferences and other project activities. No temporary field office (trailer) for the DGS Project Coordination will be required for the project.

1. The .1 Contractor shall provide the following equipment:
  - a. No equipment is required to be provided for the use of the DGS Project Coordination team.

#### 1.22 SANITARY FACILITIES

- A. General Conditions Section 19.3 is hereby deleted. The following conditions shall pertain:

1. Sanitary facilities will, within the limitations of the existing facilities, be provided by the Client Agency at no cost.
2. The existing facilities available for the Contractor's use are located on the Ground Floor. Refer to Drawing A200G.
3. The .1 General Contractor shall be responsible for periodic maintenance of the toilet facilities used by construction personnel.

#### 1.23 BUILDING ACCESSIBILITY

- A. Accessible paths to the work areas shall be via the entrance to the former Archives or through the Parking Garage/Loading Dock.

1. Refer to Drawing A200G.
2. Entrances to the Museum shall not be used by construction personnel.

1.24 SMOKING POLICY

- A. Smoking and use of smokeless-tobacco, chewing tobacco, snuff, Vape machines and similar paraphernalia are strictly prohibited in all buildings.

1.25 PERMITS

- A. The Professional, on behalf of the Department, has obtained a UCC-3 permit from the Pennsylvania Department of Labor & Industry.
- B. The .1 Contractor shall complete an LIBI-26 Application for Construction and Alteration Permit (for elevators) and obtain the permit from the Pennsylvania Department of Labor & Industry Elevator Division for modernization of Elevators 7 and 8.
  - 1. The Professional will sign and seal the UCC building permit certification section of the LIBI-26.

1.26 QUALITY CONTROL TESTING

- A. Structural-related testing and inspections required to be performed by the Contractor are listed in Section 014000 Quality Control Testing Services. If Quality Control testing or inspections required appear in Section 014000 and in a technical section, the most stringent requirements shall prevail. If Quality Control testing or inspections required appear in a technical section and not in Section 014000, they shall be required as if specified in Section 014000. Conditions pertaining to Quality Control testing and inspections may appear in the technical sections. All testing herein is to be by the Contractor. Testing by the Department, Quality Assurance Testing, is for the purpose of checking the results of the Contractor's Quality Control Testing. Testing is to be by the Contractor unless specifically stated to be "by the Department" or required by Section 014010 Quality Assurance Testing and Inspection Services.
- B. Non-structural testing is in the technical specifications.

1.27 RESTRICTED ACCESS

- A. Work on the fourth floor of the Museum may only be performed under escort by the Client Agency. All Contractors must schedule and coordinate this work with the Client Agency and Department 2 weeks in advance.
- B. The Client Agency will designate one of its staff members to act as an escort.

1.28 CLIENT AGENCY USE OF FREIGHT ELEVATOR

- A. The Client Agency will be accepting an on-loan exhibit from the Museum of Modern Art (MOMA), which includes a large-scale model of Frank Lloyd Wright's Falling Water.
  - 1. The dates for the exhibition are:
    - a. Opening Date: May 17, 2024.
    - b. Closing Date: January 5, 2025.

- B. To facilitate this on-loan exhibit, the Client Agency must have use of Elevator 8 (freight) as follows:
  - 1. April 8-19, 2024 for transport of the model for set-up.
  - 2. January 11-22, 2025 for transport of the model for take down.
  
- C. If the contractors cannot complete the modernization of Elevator 8 to accommodate the above schedule, the .1 General Contractor shall provide a means of hoisting the crated model from the Ground Floor to the First Floor.
  - 1. Crated Model Dimensions: 64 inches wide by 96 inches long by 72 inches high.
  - 2. Crated Model Weight: 917 lbs.

#### 1.29 OTHER CLIENT AGENCY COORDINATION

- A. The Client Agency's use of Command Center G is critical. The contractors shall identify the duration of contract work in this space on the overall coordinated project schedule developed by the .1 Contractor.
  - 1. Any revisions to the approved schedule shall be communicated to the Client Agency two weeks in advance.
  
- B. The Client Agency periodically schedules events in Auditorium G120 with the public. The contractors shall identify the duration of contract work in this space on the overall coordinated project schedule developed by the .1 Contractor.
  - 1. Any revisions to the approved schedule shall be communicated to the Client Agency two weeks in advance.
  
- C. The use of the chair lift at Stair 08 SG08 is critical to the Client Agency. Any disruptions to the use of the chair lift shall be communicated to the Client Agency two weeks in advance.

#### 1.30 CADD FILE WAIVER

- A. The Professional will make graphic portions of the bid drawings available for use by the Contractor by uploading files to e-Builder.
  
- B. Electronic files shall be uploaded only after all construction contracts have been executed.
  
- C. The files are provided as a convenience to the Contractor, for use in preparing shop drawings and/or coordination drawings related to the construction of this Project only. These files and the information contained within are the property of the Department and may not be reproduced or used in any format except in conjunction with this Project.
  
- D. The Contractor acknowledges that the information provided in these files is not a substitution or replacement for the Contract Documents and does not become a Contract Document. The Contractor acknowledges that neither the Professional nor the Department warrant or make any representation that the information contained in these files reflect the Contract Documents in their entirety. The Contractor assumes full responsibility in the use of these files and acknowledges that all addenda, clarifications and changes to the drawings executed as a part of the Contract Documents may or may not be incorporated in these electronic files.

- E. The Contractor acknowledges that the furnishing of these files in no way relieves the Contractor from the responsibility for the preparation of shop drawings or other schedules as set forth in the Contract between the Contractor and the Department.
- F. The electronic documents shall be stripped of the Professional's name and address, and any professional licenses and signatures indicated on the contract documents. The use of these electronic documents is solely at the Contractor's risk and shall in no way alter the Contractor's Contract for Construction.
- G. Disclaimer: The Professional and Department make no representation regarding fitness for any particular purpose, or suitability for use with any software or hardware, and shall not be responsible or liable for errors, defects, inexactitudes, or anomalies in the data, information, or documents (including drawings and specifications) caused by the Professional's or its Consultant's computer software or hardware defects or errors; the Professional's or its Consultant's electronic or disk transmittal of data, information or documents; or the Professional's or its Consultant's reformatting or automated conversion of data, information or documents electronically or disk transmitted from the Professional's Consultants to the Professional.
- H. By the Contractor's or their subcontractor's use of the electronic files (e.g., AutoCAD files), the Contractor and their subcontractor waive all claims against the Department the Professional, its employees, officers and Consultants for any and all damages, losses, or expenses the Contractor incurs from any defects or errors in the electronic documents. Furthermore, the Contractor shall indemnify, defend, and hold harmless the Department, the Professional, and its Consultants together with their respective employees and officers, from and against any claims, suits, demands, causes of action, losses, damages or expenses (including all attorney's fees and litigation expenses) attributed to errors or defects in data, information or documents, including drawings and specifications.

#### 1.31 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where design services or certifications by a design professional are specifically delegated to the Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated in the technical specification sections.
  - 1. If criteria indicated in the technical sections are not sufficient to perform services or certification required, submit a written request for additional information to the Professional.
- B. Delegated Design Services Submittals: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional registered in the Commonwealth of Pennsylvania, for each product and system specifically assigned to the Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010400

## SECTION 013100

### SEQUENCE OF CONSTRUCTION AND MILESTONES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions," "Special Requirements," and "General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 GENERAL REQUIREMENTS

- A. Before beginning work, the Contractor will be required to prepare a Project Schedule in consultation with the Department. The work must be carried out in full accordance with the schedule. The Contractor shall arrange to perform the work without any unnecessary interference with the Institution's operation.
- B. The Project Schedule shall be developed in conformance with Article 8 of the General Conditions of the Contract, except as modified and/or augmented by this Section.
- C. The detailed Project Schedule shall be developed in accordance with the Contract Documents. The submission of the Project Schedule, and all subsequent updates, shall be done in eBuilder utilizing the scheduling software native file as well as in PDF format (including all requested sorts and arrangements, utilizing color print). The attachments in e-Builder shall include all unlocked data files in the scheduling software system used to develop the schedule. The start date on the schedule shall be the Initial Job Conference and end with the Contract Completion Date. The final detailed Project Schedule must be submitted in eBuilder for Professional and Departmental acceptance within forty-five (45) calendar days of the Effective Date of the Contract or the date directed in the Letter of Intent to Contract.
- D. The use of float suppression techniques, such as preferential sequencing (arranging the critical path through activities more susceptible to Client Agency or Department caused delays), special lead/lag logic restraints, zero total or free float constraints, extended activity times or imposing constraint dates other than as required by the contract, shall be cause for the rejection of the submitted project schedule or its updates. The use of Resource Leveling (or similar software features) used for the purpose of artificially adjusting activity durations to consume float and influence the critical path is expressly forbidden.
- E. The Contractor shall also track submissions, ordering dates and delivery of materials in the Project Schedule.
- F. A large sized copy of the accepted Project Schedule shall be maintained and posted in the DGS Construction Coordinators field office for access and monitoring of the progress of the work activities. At the direction of the Department, large-sized copies of monthly schedule updates shall also be provided, posted and maintained in the DGS Construction Coordinators field office.

### 1.3 CRITICAL MATERIALS AND EQUIPMENT

- A. The Contractor is cautioned that all necessary and required critical materials and equipment shall be ordered as quickly as possible, in order that the shipping will not delay the progress of the work or completion of the project. The accepted Project Schedule shall also incorporate the milestones outlined in this Specification Section as well as additional milestones to ensure the timely completion of the project.
- B. Listed Critical/Long Lead items in this Section are not an all-inclusive list of required Critical/Long Lead submittals. All Contractors are required to perform their own review of the documents and make submissions as necessary so as not to delay the project. The Contractor shall recognize and acknowledge that all critical materials and equipment shall be ordered immediately after receipt of approved shop drawings to ensure that lead time and shipping will not delay the progress of the work or completion of the project. Any costs necessary to expedite manufacturing and/or delivery of materials and equipment to maintain the project schedule shall be the responsibility of the Contractor. No additional costs will be paid by the Department.

### 1.4 CRITICAL ITEMS TO BE NOTED AS MILESTONES

- A. Refer to the General Conditions, Article 8 'Project Schedule', regarding construction progress Milestones to be established by the Lead Contractor and completion times in calendar days after the Initial Job Conference:

#### 1. GENERAL CONSTRUCTION (DGS 946-12 4.1)

- a. Completion of Scope Item FM-1: 419 calendar days.
- b. Completion of Scope Item FM-2: 419 calendar days.
- c. Completion of Scope Item FM-3: 419 calendar days.
- d. Completion of Scope Item B-2: 187 calendar days.
- e. Completion of Scope Item B-3: 279 calendar days.
- f. Completion of Scope Item B-4: 176 calendar days.
- g. Completion of Scope Item B-5: 187 calendar days.
- h. Completion of Scope Item B-6: 157 calendar days.
- i. Completion of Scope Item B-8: 119 calendar days.
- j. Completion of Scope Item B-9: 279 calendar days.
- k. Completion of Scope Item B-10: 67 calendar days.
- l. Completion of Scope Item B-11: 279 calendar days.
- m. Completion of Scope Item B-12: 176 calendar days.
- n. Completion of Scope Item B-13: 419 calendar days.
- o. Completion of Scope Item M-7: 297 calendar days.
- p. Completion of Scope Item S-6: 249 calendar days.

#### 2. HVAC CONSTRUCTION (DGS 946-12 4.2)

- a. Completion of Scope Item B-2: 187 calendar days.
- b. Completion of Scope Item B-13: 273 calendar days.
- c. Completion of Scope Item M-4: 259 calendar days.
- d. Completion of Scope Item M-7: 297 calendar days.
- e. Completion of Scope Item E-4: 266 calendar days.
- f. Completion of Scope Item S-6: 249 calendar days.



3. PLUMBING AND FIRE PROTECTION CONSTRUCTION (DGS 946-12 4.3)

- a. Completion of Scope Item B-13: 297 calendar days.
- b. Completion of Scope Item P-2: 167 calendar days.
- c. Completion of Scope Item P-3: 167 calendar days.
- d. Completion of Scope Item P-5: 167 calendar days.

4. ELECTRICAL CONSTRUCTION (.4)

- a. Completion of Scope Item B-13: 319 calendar days.
- b. Completion of Scope Item M-4: 259 calendar days.
- c. Completion of Scope Item M-7: 297 calendar days.
- d. Completion of Scope Item P-5: 137 calendar days.
- e. Completion of Scope Item E-1: 229 calendar days.
- f. Completion of Scope Item S-1: 279 calendar days.
- g. Completion of Scope Item S-2: 279 calendar days.
- h. Completion of Scope Item S-3/S-4: 279 calendar days.
- i. Completion of Scope Item S-6: 249 calendar days.

C. Time is of the essence for this contract.

- 1. If the Contractor fails to meet milestones, the Department shall assess the Contractor, as Liquidated Damages, not as a penalty for such failure, the sum stipulated within the bid documents per calendar day, until all milestones are met, and all work is completed and accepted by the Department. Liquidated Damages are also applicable and assessable for noncompliance with the dates listed in the accepted Project Schedule.

D. The milestones listed are intended only to assist the bidders in understanding the potential flow of the work and enumerate some of the critical milestones that will be incorporated into the Project Schedule. The Contractor will be responsible for determining the actual order of the required milestones and the logic of the Project Schedule as required to complete the project the time-period indicated in the bid documents.

E. The Contractor is advised that the schedule may require multiple crews to work concurrently in all areas of the building(s). When multiple areas are worked concurrently, the Contractor is required to supervise, staff and equip the job accordingly.

F. It shall be understood that there shall be a number of independent work activities occurring by other means of procurement and by other contractors and vendors outside this project. The other work activities shall commence prior to the Final Inspection and/or Closeout Inspection for this project. As such, the Contractor shall have an affirmative duty to accommodate this effort while working with and cooperating with all these other entities, individually or collectively, as well as with the Department and Client Agency. The Milestones denoted in this Section are established to define the anticipated sequence and identify the areas (as well as time frames) that must be completed to facilitate this effort. The Contractor shall provide the necessary additional supervision, project management and overall coordination necessary to expedite the work being performed by these other entities. The Contractor shall consider this condition and include any costs associated with this effort in their bids.

## 1.5 SEQUENCING OF CONSTRUCTION AND OTHER REQUIREMENTS

- A. The overall project must be fully completed and ready for a Final Inspection within 419 calendar days from the date of the Initial Job Conference. There are numerous events that occur in the facility. All work by the Contractor must be thoroughly and properly coordinated with the facilities event schedule to achieve a timely completion of the project. In addition to the milestones shown in this Section, the Contractor must develop their own milestones, which must be incorporated into the Project Schedule. This Section of the specifications includes a brief narrative of the specific milestones that will be incorporated into the Project Schedule as contractual obligations, along with special requirements and constraints. The Contractor shall be responsible for reviewing these requirements to determine the effect, as it relates to their scope of work, temporary protection, material deliveries, manpower schedule, shift work, equipment required, etc.
- B. When the Work of this Project includes longer than industry standard lead-times for materials or equipment for which all other tasks on the Project Schedule become dependent, the Department may issue a notice of a temporary suspension of the Work. If temporarily suspended, the Contractor must notify the Department at least thirty (30) days prior to the delivery date of the materials or equipment. Upon such notice, the Department will terminate the suspension and direct resumption of the Work to occur on or about the delivery date. The Contractor, in consultation with the Department, will evaluate the length of time needed to complete the project and a non-compensatory Extension of Time Change Order may be submitted by the Prime Contractor(s), which the Department will review in accordance with the Administrative Procedures governing Extensions of Time. During the temporary suspension, the Contractor will be responsible to maintain all installed temporary facilities.

## 1.6 CONSTRUCTION PROGRAM

- A. The entire scope of work for the Project (as indicated on the Drawings and Specifications, including all bulletins, addenda and modifications thereto) shall be completed within the time-period outlined in this Section of the specifications and in accordance with the hereinafter-specified requirements. It shall be the responsibility of the Contractor to inform all suppliers and subcontractors (of any tier) of the construction program procedures. Due to the event schedule of the Pennsylvania State Museum, work activities shall be performed concurrently; thereby creating accelerated work and inefficient conditions. The Contractor shall recognize and acknowledge that these working conditions will exist as contractually inherent features of this Project. The Contractor shall account for these conditions in their bid. No additional compensation will be paid for failing to include all requirements as set forth in the construction program.
- B. Time is of the essence for this Contract. The Contractor and all their subcontractors (of any tier) shall employ a sufficient number of qualified employees, supervision/management, equipment and project resources, required to meet the milestones and completion date established for this Project. It may be necessary for all activities to be performed concurrently such that required completion dates (including completion of punch list and obtaining Pennsylvania Department of Labor & Industry [L&I] Certificate of Occupancy/Utilization) are met as identified in this Section. The Contractor is required to employ multiple crews with necessary manpower, equipment, materials, supervision/management, etc., to perform the aforementioned concurrent work activities. If the Contractor elects to perform work off-shift, proper supervision must be provided for all work activities. No work shall be covered or concealed during off-shift work activities in such a manner that it cannot be observed the morning of the next work shift. See Paragraph 1.6F of this Section regarding L&I inspections.

- C. Preinstallation meetings are required for many items and systems. The preinstallation meeting shall be held the same dates as the regularly schedule bi-weekly job conferences. The Prime Contractor shall coordinate with the Department any preinstallation meeting scheduling requirements to avoid delays in the installation of any items or systems requiring a preinstallation meeting. The Contractor shall request the meeting a minimum of four weeks prior to the scheduled installation of the item or system. Failure to request a preinstallation meeting in the required time-period will not relieve the Contractor of their responsibility to comply with all contract documents including, but not limited to, the Project Schedule. No additional compensation or extension of time will be granted by the Department to the Contractor for their failure to schedule or attend any of the required preinstallation meetings.
- D. The Contractor shall coordinate with the Department any scheduling requirements to avoid disruption of programs, events or activities, as well as to coordinate the location of the various structures to be such as, but not limited to, temporary construction fences, temporary roof access, etc. All work performed under this Project shall be done in a manner that will not disrupt normal activities in and around the facility.
- E. The Contractor may work outside of normal work hours as necessary, in shifts and on weekends, to maintain the Project Schedule. The Contractor is to comply with noise level restrictions in accordance with all local ordinances and the Client Agency.
- F. The Contractor shall coordinate and schedule inspections as required by the provisions of the Building Permit issued by L&I. The L&I inspectors will be available during the day shift. L&I inspector availability does not constitute a delay to the progress of the project and shall be considered by the Prime Contractor when scheduling and completing the work of this project.
- G. It is understood that during the duration of the Project, changes may be made to the Project Schedule without the Department incurring additional costs or granting extensions of time to the Contract.
- H. Change Orders shall occur on this project to address unforeseen conditions, errors and/or omissions in the documents and other potential conflicts. It shall be mandatory that the Contractor (along with all their subcontractors of any tier) provides necessary additional work forces to accommodate these changes in a manner to eliminate any delays to milestones or the overall project schedule. The Department will issue no Extension of Time for performance of Change Order work; all time must be recovered in the affected work activities.
- I. The Department reserves the right to delay or suspend any work, without compensation due the Contractor, if the Department determines that any work would disrupt activities in or around the facility.
- J. In the event that:
  - 1. The Contractor fails to achieve any interim milestones established for the building program in accordance with the Contract Documents and the Project Schedule.
  - 2. Any schedule update showing the work behind schedule and in jeopardy of meeting the accepted milestone dates.

The Department will notify the Contractor that they are in default of the contract. The defaulting Contractor will be given three (3) calendar days to correct the deficiency. In the event the defaulting Prime Contractor fails to correct the deficiency within three (3) calendar days or fails to staff the job properly or work the required shifts/overtime/weekends necessary to maintain the schedule and achieve the milestones; in addition to liquidated damages the Department may take necessary actions to ensure that the Project Schedule is maintained. All costs and fees associated with such supplementation shall be deducted from the defaulting Contractor's contract value.

- K. Unless directed otherwise by the Department, immediately upon the issuance of the Letter of Intent to Contract, the Contractor shall begin the submittal process and shall have all critical submittal items for the project submitted to the Professional within fourteen (14) calendar days after the issuance date of the Letter of Intent to Contract (in accordance with Paragraph 1.3 of this Section). The Contractor shall submit their Priority Submittal Schedule to the Professional with seven (7) calendar days of the issuance date of the Letter of Intent to Contract. The Contractor shall have all remaining submittal items submitted to maintain the construction schedule. The above shall not be considered justification for delay or claim by the Contractor.
- L. While time is of the essence, the Contractor (as well as each of their subcontractors of any tier) shall not compromise the safety of any individuals while performing any of their work. Contractors shall take all the necessary precautions to maintain safety during the progress of the work including, but not limited to, fall protection, shoring, barricades, signage, safety tape and rails, temporary ramps, temporary roads, temporary partitions, fencing, etc.

#### 1.8 FURTHER CLARIFICATIONS

- A. By submitting a Bid, the Contractor acknowledges that this abbreviated list of milestones for construction work (as provided in this Section) was provided for informational purposes, and to ensure the Contractor understands the critical mandatory completions/durations necessary to accommodate the requirements and sequence of completion to meet the needs of the client Agency. It constitutes a proposed sequence of events based on standard construction practices and will not form the basis for any claims for inefficiency, acceleration or delays. The coordinated Project Schedule will be developed in accordance with the Section and the Contract Documents by the Contractor and the actual milestone dates for the project will be agreed upon by the Contractor based on the accepted schedule.
- B. If there is a conflict between what is stated in this Section and the General Conditions of the Contract, the contract specifications, the contract drawings or the Administrative Procedures, the most stringent requirement within any of these documents shall prevail.

#### 1.9 WORK IN OCCUPIED BUILDING

- A. The scope of work for this project includes work inside the buildings at the Pennsylvania State Museum and Archives buildings. The Archives building will be unoccupied during the construction period. The following shall apply to Work within the Museum building.
  - 1. The contractor shall schedule and coordinate the interior work with the Client Agency's Event Schedule.
  - 2. The contractor shall provide the appropriate protections to avoid damage to adjacent surfaces and finishes.
    - a. All collateral damage to adjacent surfaces and finishes shall be repaired to match preconstruction conditions and approved by the Professional at no cost to the Department.
  - 3. In the event the interior work cannot be completed in 1 working day, the contractor shall secure the area and render it free of hazardous conditions before leaving the work area.
- B. The work areas inside the building shall be cleaned by the Contractor before its employees leave the area each shift.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

## SECTION 014000

### QUALITY CONTROL TESTING SERVICES

#### PART 1 – GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections, "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 GENERAL

- A. The Contractor is responsible for verifying and enforcing compliance with all requirements of the Contract Documents. Contractor's responsibility includes, but is not limited to, the following:
  - 1. Supervision of field work to enforce contract compliance of all construction activity.
  - 2. Verification of compliance with plans and specifications of all manufactured materials or equipment. Provide certificates of compliance, or other approved proof of compliance, by the manufacturers and submit to the Professional.
  - 3. Performance of all necessary field measurements and/or inspections to verify compliance with requirements of the plans or specifications requiring adherence to measurable standards of field performance.
  - 4. Engaging an independent testing laboratory to perform tests and inspections as required by this specification section, hereafter referred to as Quality Control Testing and Inspection Services or Quality Control Testing Services.
  - 5. Providing support services for all Quality Control Services, including cutting and patching and repair or replacement as required.
- B. Work not included: Quality Assurance Services by the Department are specified in Section 014010. The Department reserves the right to perform tests under the Quality Assurance Testing program and to use those as the basis for approval or rejection at its sole discretion.

##### 1.3 DESCRIPTION OF QUALITY CONTROL TESTING

- A. Quality Control Services include inspections, tests and reports by an independent testing laboratory or other approved agency, hereafter referred to as the Quality Control Agency. All Quality Control Services shall be at the Contractor's cost, which shall be included proportionally in all items of payment or contained in any Base Bid or Unit Price on the Proposal. Tests and Inspections are to include those specifically required by this section and within technical sections of the Project Manual.
- B. The Quality Control Agent shall submit a Testing and Inspection Plan to the Professional for its approval, and the approval of the Quality Assurance agent for all tests and inspections required by this section and within technical sections of the Project Manual.
- C. Quality Control Services by a Quality Control Agency or Agencies is intended to assist in the determination of probable compliance of the work with requirements specified or indicated and do not relieve the Contractor of the responsibility for compliance with Contract Document requirements.

- D. Specific testing or inspections of a structural nature required to be performed by independent Quality Control Agencies for individual construction activities are specified in this Section only. If testing or inspection requirements appear in this section and a technical section, the most stringent requirements shall prevail. If Quality Control Testing or Inspection is specified in a technical section and not in this section, it shall be required as if specified in this section. Non-structural tests and inspections are in the technical specifications.
- E. Inspections, tests and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Documents requirements.
- F. Quality Control Services required by the local municipality or other governing authorities are the responsibility of the Contractor, regardless of whether or not specified hereinafter or in the applicable specification section.
- G. Each prime Contractor will pay for all costs in connection with its Quality Control Services. Whenever the word "Contractor" is used it shall be interpreted to mean Prime Contractor or Contractors as applicable. All Contractors performing work for which testing or inspection is required by this section are required to perform said tests/inspections appropriate for the quantity of work performed as indicated by this specification section and as required by all Contract Documents.

## PART 2 – PRODUCTS (Not Used)

## PART 3 – EXECUTION

### 3.1 RESPONSIBILITIES AND DUTIES OF CONTRACTOR

- A. The Contractor shall engage Quality Control Agencies to provide all Quality Control Services required to comply with the Contract Documents. These services shall be at no cost to the Department.
- B. The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and indicate non-compliance with Contract Document requirements. Likewise, the Contractor is responsible for retesting when the Department's Quality Assurance Test results prove unsatisfactory. If Quality Assurance Tests were in error, the Contractor shall be reimbursed for his retesting costs.
- C. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility.
- D. Provide the Quality Control Agency with preliminary representative samples of materials to be tested in quantities requested. If the source, quality or characteristics of an approved material changes or indicates lack of compliance with Contract requirements, submit additional samples of materials to the Quality Control Agency.
- E. When requested by the Professional, the Department, or the Quality Control Agency, the Contractor shall immediately provide reports, cutting lists, material bills, shipping bills, time and place of shipment of materials to shop and field and any relevant data on previous testing and investigations of materials.
- F. Provide casual labor and facilities:
  - 1. To provide access to the work inspected or tested by any authorized party.
  - 2. To obtain and handle samples at the site.

3. To facilitate inspections and tests by the Quality Control Agency or Quality Assurance Agency.
  4. For security and protection of samples and test equipment at the project site.
- G. To facilitate the timely sequence of inspection and testing, the Contractor shall give advanced notification to the Quality Control Agency and the Department that work has progressed to a point where inspection and testing may proceed.
- H. Contractor shall pay for additional cost of Quality Control Agency services which, in the opinion of the Professional and the Department, are required because of the following:
1. Failure of materials or workmanship to meet Contract requirements.
  2. Materials or practices not complying with the technical specifications which could possibly result in defective and unacceptable work.
  3. Changes in source, quality or characteristics of materials.
  4. Site cured concrete cylinders requested by the Contractor.
- I. The Quality Control Agency shall submit a certified written report of each inspection, test or similar service to the Design Professional, the Quality Assurance Agent, the Bureau of Construction Regional Director, Project Manager and Assistant Project Manager, and the Contractor, with additional copies directly to any governing authority when that authority so directs. All reports shall be uploaded to e-Builder within 24 hours of when the inspection occurs, test is conducted, test results obtained or similar service was conducted.
- J. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:
1. Date of issue.
  2. Project title and number.
  3. Name, address and telephone number of testing agency.
  4. Dates and location of samples and tests or inspections.
  5. Names of individuals making the inspection or test.
  6. Designation of the Work and test method.
  7. Identification of product and specification section.
  8. Complete inspection or test data.
  9. Test results and an interpretation of test results.
  10. Ambient conditions at the time of sample taking and testing.
  11. Comments or professional opinion as to whether inspected or tested work complies with Contract Document requirements.
  12. Name and signature of Quality Control Agency inspector.
- K. The QC Agent shall cooperate in using standard forms/procedures developed by the Department that assist in accomplishing the tasks required.
- L. Engage independent testing laboratories, whose employees assigned to the Project and tests performed comply with ASTM E 329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction. The testing laboratory must be accredited and audited by a qualified national authority. The Contractor is to submit the name and credentials of the proposed QC Agent to the Design Professional and the Department for acceptance.
- M. Upon completion of inspection, testing, sample taking and similar activities, repair the damaged work and restore substrates and finishes to eliminate deficiencies, including deficiencies in the visual qualities of exposed finishes. Comply with the Contract Document requirements for "Cutting and Patching". Protect work exposed by or for Quality Control Testing activities, and protect repaired work.



- N. All required testing/inspection, including that stated in the body of the technical specification sections (be it referenced in the technical specifications as “Quality Control”, “Quality Assurance”, or any other referenced testing and/or inspection) shall be performed by the Contractor, unless it explicitly states it shall be performed by the Department. If stated to be performed by the Department, the Contractor shall still be required to perform all necessary testing/inspection in advance of the Department to assure the work meets all the requirement of the contract documents.
- O. Contractor shall coordinate closely with the Department, the Professional and the Professional’s QA Agencies and Consultants so that any required or desired QA testing can be performed concurrently or immediately after the Contractor’s QC testing.

3.2 RESPONSIBILITIES AND DUTIES OF QUALITY CONTROL AGENCIES

- A. Quality Control Agencies engaged to perform inspections, sampling and testing of materials and construction shall cooperate with the Professional, the Quality Assurance Agent, the Department, the Department of Labor and Industry, and the Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests. If it is determined by the Department that the personnel provided are not qualified or are not working in the best interests of the Project for the tests performed, the Contractor, through their Quality Control Agent, shall immediately replace or supplement the subject personnel.
- B. Quality Control Agencies shall notify the Department, the Quality Assurance Agent, the Professional, and the Contractor immediately of irregularities or deficiencies observed in the Work during performance of its services.

3.3 QUALITY CONTROL SERVICES TO BE PERFORMED

- A. Testing and inspections by the Quality Control Agency or Agencies shall include, but are not limited to, the following list.

**LIST OF TESTS AND INSPECTIONS**

DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	QUANTITY OR FREQUENCY
<b>CONCRETE</b>		
Practice for Sampling Freshly Mixed Concrete. (5 cylinders/test) Perform air tests when sampling concrete. Perform slump tests and record temperature for all concrete deliveries.	ASTM C143, C1064, C231 or C173 or C138, C172, C31	For each mix, 1 test for each day of concreting or for each 50cy, whichever is greater.
Compressive Strength of Cylindrical Concrete Specimens	C39	For non-structural concrete, 1 test for each 100cy is adequate.
Inspection of Adhesive Anchors	ACI 318; 2009 IBC: Section 1704.4	Periodic

END OF SECTION 014000

## SECTION 014010

### QUALITY ASSURANCE TESTING AND INSPECTION SERVICES

#### PART 1 – GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 GENERAL

- A. All testing and inspecting specifically called for and/or described in this section of the specifications are referred to as Quality Assurance Services and are the responsibility of the Quality Assurance Agency. Except as hereinafter specified, Quality Assurance Services will be performed without expense to the Contractor. The Quality Assurance Agency is an independent testing and inspecting agency engaged by the Department through the Professional. Testing required because of changes in materials or proportions at the request of the Contractor shall be at the Contractor's expense. The Professional may engage more than one Quality Assurance Agency to perform services. Whenever the word "Contractor" is used it shall be interpreted to mean Prime Contractor or Contractors as applicable.
- B. Work Not Included: Quality Control Testing to be performed by the Contractor is specified in Section 014000.

#### PART 2 – PRODUCTS (Not Used)

#### PART 3 – EXECUTION

##### 3.1 RESPONSIBILITIES AND DUTIES OF THE CONTRACTOR

- A. The use of Quality Assurance Services shall in no way relieve the Contractor of its responsibility to furnish materials and construction in full compliance with the plans and specifications or to perform Quality Control Testing where specified.
- B. To facilitate Quality Assurance Inspection or Testing, the Contractor shall:
  - 1. Secure and deliver to the project site, without cost, representative samples of materials it proposes to use and which are required to be tested under Paragraph 3.4, 'Tests and Inspections'.
  - 2. Furnish such casual labor as is necessary to obtain and handle samples at the project or at other sources of material.
  - 3. Provide means of safe access to work areas, provide conditions that allow testing and inspection to take place, provide materials for testing as requested, patch test sites when completed and furnish incidental labor and assistance necessary for inspectors of the Quality Assurance Agency to perform their tests and inspections.

### 3.2 AUTHORITY AND LIMITATIONS OF QUALITY ASSURANCE AGENCY

- A. Personnel representing the Quality Assurance Agency will not act as foremen nor perform other duties for the Contractor.
- B. Work will be checked as it progresses, but failure to detect any defective work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Department or the Professional for final acceptance.
- C. The Quality Assurance Agency is not authorized to revoke, alter, relax, enlarge, or release any requirements of the specifications, nor to approve or accept any portion of the work.
- D. The Quality Assurance Agency shall report all test and inspection results to the Professional, the Department and the Contractor immediately after they are performed. Selection and frequency of tests shall be at the discretion of the Professional and the Department. All reports shall be uploaded to e-Builder within 24 hours of when the inspection occurs, test is conducted, test results obtained or similar service was conducted.
- E. Written reports of each inspection, test or similar service shall include but not be limited to:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address and telephone number of testing agency.
  - 4. Dates and location of samples and tests or inspections.
  - 5. Names of individuals making the inspection or test.
  - 6. Designation of the Work and test method.
  - 7. Identification of product and specification section.
  - 8. Complete inspection or test data.
  - 9. Test results and an interpretation of test results.
  - 10. Ambient conditions at the time of sample taking and testing.
  - 11. Comments or professional opinion as to whether inspected or tested work complies with Contract Document requirements.
  - 12. Name and signature of Quality Control Agency inspector.
- F. When it appears that any material furnished or work performed by the Contractor fails to fulfill contract requirements, the Quality Assurance Agency shall report such deficiency to the Professional, the Department and the Contractor.

### 3.3 CONTRACTOR'S FAILURE TO MEET CONTRACT REQUIREMENTS

- A. The Department and the Professional reserve the right to reject any items which do not meet the requirements of the plans and specifications and will require the contractor to replace these items and bear all expenses in connection with such replacements.
- B. The Contractor shall pay all costs incurred in providing additional testing and/or analysis (including engineering fees) required because of deficient test results or construction not in compliance with requirements of the Contract Documents.

### 3.4 TESTS AND INSPECTIONS

- A. Tests and inspections listed below may, at the discretion of the Professional and the Department, be performed by an independent Quality Assurance Agency engaged by the Department through the Professional, without expense to the Contractor. The Department reserves the right to change this list at any time.

<u>REQ'D BY<sup>1</sup></u>	<u>DESCRIPTION OF TEST OR INSPECTION</u>	<u>REFERENCED STANDARD</u>	<u>IBC REFER-ENCE<sup>2</sup></u>
	<b>CONCRETE</b>		
IBC	1. Inspection of adhesive anchors installed in hardened concrete	ACI 318: 3.8.6, 8.1.3, 21.2.8	1704.4
IBC	2. Verifying use of required design mix	ACI 318: Ch. 4, 5.2-5.4	1904.22, 1913.2, 1913.3
IBC	3. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content test, determine the temperature of the concrete	ASTM C172, C31; ACI 318: 5.6, 5.8	
IBC	4. Inspection for maintenance of specified curing temperature and techniques	ACI 318; 5.11-5.13	1913.9
DGS	Review Contractors' design mixes, Certificates of Compliance and material test reports		
DGS	Compressive Strength of Cylindrical Concrete Specimens <sup>2</sup>	ASTM C39	

Footnotes:

1. "DGS" are test required by DGS and "IBC" are tests required by Chapter 17 of the 2009 International Building Code.
2. IBC 2009.
3. Quality Assurance for soils shall be performed/provided by the Professional's Foundation Consultant/Geotechnical Engineer under a separate work order issued by the Department to the Professional.
4. Refers to reference ACI 530/ASCE 5/TMS 402.
5. Refers to reference ACI 530.1/ASCE 6/TMS 602.
6. Concrete, mortar and grout molds are to be made by QA Agent Under Special Inspection hours.

END OF SECTION 014010

SECTION 015000  
TEMPORARY UTILITIES

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 TEMPORARY SERVICES DURING CONSTRUCTION

- A. The designated Contractor shall install, operate, protect and maintain the temporary services, as hereinafter specified, during the construction of the entire Project.
- B. Temporary connections to new and/or existing permanent service lines shall be made at locations as directed by the Department, in conjunction with the Client Agency (as applicable), and when the temporary service lines are no longer required, they shall be removed by the Contractor. Any part or parts of the permanent service lines, grounds and building, disturbed and damaged by the installation and/or removal of the temporary service lines, shall be restored to their original condition by the Contractor responsible for the temporary installation.
- C. If the Contractor fails to carry out its responsibility in supplying temporary services as set forth in this Contract, it is responsible for such failure and the Department may take such action as it deems proper for the protection and conduct of the work, and shall deduct the cost involved from the amount due the Contractor. Only those temporary utilities required for construction need to be extended to the work area(s).
- D. The Client Agency will not charge a usage fee for electric power consumed for construction services.

1.3 TEMPORARY WATER SUPPLY

- A. Water required for construction operations will be made available by the Client Agency from one of the janitor's closets within the Museum and Archives.
  - 1. The Client Agency will not charge for water used for construction sources.

1.4 TEMPORARY HEAT

- A. The traditional temporary building heat requirements are not required for this Project. The existing heating and cooling system will be in operation throughout the duration of the construction period.

## 1.5 CONSTRUCTION LIGHT AND POWER

- A. Prime Contractors may use the 120-volt receptacles located throughout the Museum and Archives.
  - 1. The Client Agency will not charge a usage fee for electric power consumed for construction activities.
  - 2. Each Prime Contractor shall provide its own properly sized extension cords from the existing receptacles. Locate and secure extension cords to avoid tripping hazard.
  - 3. All Prime Contractors using existing receptacles for construction power shall research the loading of the existing circuits and shall avoid overloading circuits.
    - a. The Department and Client Agency recently completed a power upgrade to the Museum and Archives under DGS Project No. 948-78. As-built drawings will be made available.
  - 4. All Contractors requiring electrical power of voltages greater than 120 volts shall provide self-contained engine generating units.
    - a. Do not locate generators within the Museum or Archives, or in areas where fumes will enter buildings.
- B. Temporary Lighting:
  - 1. The .4 Electrical Contractor shall provide temporary LED string lighting in all areas where the scope includes removal of existing light fixtures.
    - a. Temporary lighting shall be installed immediately after existing light fixtures are demolished and removed. Temporary lighting shall remain in place until permanent lighting is installed.
  - 2. Areas requiring temporary lighting include the following:
    - a. Fire Command Center G 40A.
  - 3. Each Prime Contractor requiring supplemental light greater than the temporary lighting shall provide its own portable light fixtures.

## 1.6 WELDING

- A. Any Contractor using electrical power for welding on the site shall use self-contained engine generating units.
  - 1. Do not locate generators within the Museum or Archives, or in areas where fumes will enter buildings.
- B. Any welding activities must be pre-approved by the Client Agency in accordance with Section 016200.

1.7 FIRE EXTINGUISHERS

- A. Each Contractor shall provide UL listed, NFPA approved fire extinguishers, ten (10) lb. minimum, at each construction work area, suitable for all types of fires in accordance with OSHA.

1.8 TEMPORARY EGRESS SIGNAGE

- A. The .1 Contractor shall provide all temporary egress signage to direct occupants of the Museum and Archives around each construction area.
- B. Temporary signage shall be printed by a professional printing company in accordance with the details indicated.
  - 1. Signage shall be printed in color on 50 lb. minimum paper and shall be laminated.
  - 2. Temporary signage graphics and colors shall be reviewed and approved by the Client Agency.
  - 3. Tape or fastening methods must be reviewed and approved by the Client Agency.
  - 4. Inspect temporary signage on a weekly basis and repair or replace signage as required.

1.9 TEMPORARY PROTECTIONS

- A. Each Prime Contractor shall provide temporary protection around work areas to protect the users of the Museum and Archives, direct them around the work areas, and prevent the spread of construction dust.
  - 1. All Prime Contractors performing cutting and grinding operations shall protect HVAC supply and return diffusers located within 50 feet of the work area with MERV 4 filter material.

1.10 INTERRUPTION OF SERVICES

- A. Each Prime Contractor shall have all needed equipment and material to complete planned work at the site, prior to shutting down any system.
- B. No additional compensation or time will be given to the Contractor, if work must be performed on State or National Holidays or on weekends or on overtime. See paragraph on 'Working Hours' under Section 01040.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 015000

## SECTION 016200

### HISTORICAL AND MUSEUM COMMISSION PROJECTS – SUPPLEMENTAL PROVISIONS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and have the same force and effect as if printed herewith in full.

##### 1.2 WORK IN AND AROUND HISTORICAL SITE AND HISTORICAL BUILDINGS

- A. The use of the word “Contractor” in this Section shall mean all Prime Contractors.
- B. The Project site is an operating museum that accommodates tours of groups as well as individual visitors. In addition, The Project site and its various buildings may be recognized as one of the most highly visible and historically significant landmarks in the state, and they gain part of their cultural importance from the open spaces, the grounds, and the buildings. The Contractor will be expected to exercise a special degree of care and skill, and it must be sensitive to the problems associated with historical buildings, particularly those containing a public use. The Contractor is entrusted with a property, in some cases an irreplaceable landmark, the value of which is highly regarded by the citizens of the Commonwealth of Pennsylvania. Also, the Contractor shall ensure that its operations and the conduct of its employees are appropriate to the type of work done in a museum environment.
- C. All work within the Museum must be conducted with extreme care for the interior finishes. Neither the work itself nor the temporary protection measures can damage the finishes in the Museum. Finishes within the area of work are to be protected from damage, including floors, walls and ceilings. Finish materials to be protected include terrazzo, travertine, wood, brushed aluminum, vinyl wall covering and plaster. In addition, railings, gates and artifacts within the space must be preserved and work in these areas must be undertaken with care.
- D. The Contractor shall comply with the Secretary of the Interior’s Standards for the Treatment of Historic Properties, as applicable.
- E. The Contractor shall provide at least 48-hours-notice prior to any excavation on the site. The Commission Archaeologist shall have the right to stop the work for a period-of-time, not to exceed 5 business days, to perform mitigation archaeology at no additional expense.
- F. All finishes and objects within the area of work are to be protected from damage, including floors, walls, ceilings, objects and artifacts. Finishes and objects within the path of travel for materials are also to be protected from damage.

##### 1.3 REFERENCE

- A. The Secretary of the Interior’s Standards for Historical Preservation Projects, by reference, shall become part of this specification. <https://www.nps.gov/tps/standards/four-treatments/standguide/index.htm>
- B. “Commission” and “Client Agency” refer to the Pennsylvania Historical and Museum Commission.



#### 1.4 DAMAGE REPAIR

- A. Repair, at no cost to the Commission or the Department, any areas of the existing building, contents, landscaping, paving or other site features damaged during the work, to the satisfaction of the Commission's Project Manager and the Department. These buildings contain important historical collections and/or finishes. If damage occurs to these collections and/or finishes as a result of the work, the Contractor shall hire a Conservator, from a list supplied by the Commission, to assess the damage and recommend conservation measures required, at no expense to the Commission or the Department. Upon acceptance by the Commission and the Department of the Conservator's Assessment Report, the Contractor shall arrange for the Conservator to perform those conservation measures on the damaged objects and/or finishes at no additional cost to the Commission or Department.

#### 1.5 SYSTEMS INSTALLATION

- A. The Contractor shall review his procedures for systems installation prior to beginning any work at the site or in specific building areas to the approval of the Department and the Commission representative.

#### 1.6 SALVAGE

- A. No existing material shall be disposed of without the approval of the Commission's Project Manager. Do not reuse materials scheduled to be removed from the site, except as specifically identified or allowed by the Drawings and Specifications, or as directed by the Commission's Project Manager. Store materials designated by the Commission's Project Manager for salvage by the Commission at a location on site designated by the Commission's Project Manager.

#### 1.7 IDENTIFICATION OF HISTORICAL ELEMENTS

- A. Historically significant elements within the Museum and Archives work include, but are not limited to, the following:
  - 1. Terrazzo floors throughout.
  - 2. Travertine wall panels located within Memorial Hall, Floors 1 through 3.
  - 3. Walnut veneer wall panels throughout.
  - 4. Bronze William Penn statue located at Memorial Hall, first floor.
  - 5. The cast bronze ornamental gates that flank the north and south sides of the William Penn statue, located at Memorial Hall, first floor.
  - 6. The William Penn Charter display case at the west end of Memorial Hall, first floor.
  - 7. Ornamental chandelier hanging over the entry at the east end of Memorial Hall, first floor.
  - 8. All displays within the exhibit areas on Floors G (Ground) through 3.
  - 9. Refer to Photographs 1 through 7 at the end of this Section as examples of the above.

#### 1.8 PROTECTION METHODS

- A. All work within exhibit areas must not commence until protection of the exhibits adjacent to the work area is in place. The Prime Contractor performing the work shall be responsible for providing and removing the protection.
  - 1. The Client Agency shall specify protection to be provided and approve installation of protection before the Work in the immediate proximity can proceed.

B. Industry and Technology Aircraft Exhibit on 2<sup>nd</sup> floor.

1. The .1 Contractor shall hire a conservator to remove and reinstall the suspended aircraft at the 2<sup>nd</sup> floor Industry and Technology exhibit in order that the ACM abatement of the acoustical ceiling finish can take place.
  - a. Conservator must be included on the Client Agency's prequalified list or be reviewed and approved by the Client Agency.
  - b. The .1 Contractor shall prepare and submit a detailed plan for the removal and reinstallation of the aircraft. The plan is subject to review and approval by the Department, Client Agency and Professional
    - 1) The Client Agency will temporarily close some of the exhibit area adjacent to the 2<sup>nd</sup> floor abatement area to create a staging/storage area for the aircraft.
  - c. Conservator: Subject to compliance with requirements, provide protection services by one of the following, or another firm reviewed and qualified by the Client Agency.



- 1) John Hartmann <http://www.harmannconservation.com>.
- 2) Ian Howard <http://www.brhoward.com>.
- 3) Atelier Art Services and Storage <http://www.atelierstorage.com>.

C. All terrazzo floors subject to rolling loads shall be protected with a minimum of 3/4-inch plywood and 3/8-inch carpet underlayment.

1. Extend carpet underlayment 6 inches beyond edges of plywood.

1.9 PRECAUTIONS FOR FURNISHINGS

- A. The Contractor is advised that all furnishings contained in museum, such as furniture, collections, artifacts, draperies, exhibit materials, fixtures, etc., shall not be moved, relocated, or otherwise affected by the Contractor or its workmen. These procedures shall be effected and/or completed by the professional staff of the Client Agency. The Contractor shall provide its plan and schedule of specific work areas at least five (5) days prior to the actual start of work. It shall be the Client Agency's responsibility to affect the moving or relocation of the subject items in the defined areas to allow the Contractor's procedure of work. Where removal of furnishings and/or other items noted herein is considered impracticable or a hardship, they shall remain in place or be confined to a specific area which would not impede the Contractor's work. The Contractor shall provide proper protective coverings and attachments for placement by the Client Agency staff, or the Client Agency and Department shall direct the Contractor to erect suitable barriers to protect the stored material. The Contractor shall inform its workers of their responsibility for observing and maintaining the complete protection of the stored material.

1.10 FIRE SAFETY PRECAUTIONS

- A. The entire job site is considered a non-smoking area and smoking and smoking paraphernalia are not permitted. The Contractors shall strictly prohibit all workers from smoking on the job site.
- B. Cutting with torches, welding equipment, or other heat generating equipment, tools, will not be permitted, unless specifically approved by the Client Agency's Project Manager and Department. If such work is approved, a fire watch and fire extinguisher, with a worker trained in its operation, shall be present during the entire time of any "hot" work.

- C. A fire inspection must be conducted by the Contractor doing the hot work and documented by email to the Department and Client Agency project manager before leaving the site.
- D. Hot work must be completed 60 minutes before fire watch is conducted by Contractor who has done the hot work. Contractor must provide an email reporting time of completion of work and time of fire watch and results to DGS and Client Agency.

#### 1.11 WORK PRIOR TO EXCAVATION

- A. Not applicable to this project. The limited excavation work is not anticipated to encounter artifacts.

#### 1.12 PHOTOGRAPHS

- A. In addition to the photographic requirements stated in the General Conditions, the following photographic requirements for the Client Agency shall be part of the work. Each Prime Contractor shall submit the required number of photographs per work day to document the following:
  - 1. The existing conditions before work begins.
  - 2. Items uncovered, or exposed, particularly if they are unusual or of potential historical significance.
  - 3. The progress of the Project.
  - 4. Mechanics performing the work.
  - 5. Items as they are being closed-up.
  - 6. The completed Project.
- B. Provide digital photographs, two (2) color prints of each, matte finish, approximately 4" x 6" size, professionally printed on high quality photo paper.
  - 1. Identify photographs with date, time, direction, and Project Name/Number on the back of each print.
  - 2. Place all prints in archival sleeves, comparable to "Vue-All Photo Saver", product number 6028 (available at most photo stores). Place the dates on the sleeves with a permanent marker.
  - 3. Submit a photo key for each set of photographs. The key should describe each view, the direction of the view, and the names of any individuals in the view.
  - 4. Submit the two (2) sets of photo prints, two (2) copies of the photo key, and two (2) digital disks of photos to the Client Agency Project Manager in a three-ring binder upon completion of the Project.

#### 1.13 PREQUALIFIED RESTORATION SPECIALISTS- STONE REPAIRS

- A. Subject to compliance with requirements, provide stone restoration by one of the following.
- B. All stone repair and restoration work specified in Section 040140 "Maintenance of Stone Assembles" must be provided by one of the following masonry restoration specialists, or another firm as reviewed and approved by the Client Agency:
  - 1. Fairmount Park Conservancy; [tmcoyle@fairmountparkconservancy.org](mailto:tmcoyle@fairmountparkconservancy.org) (Tom McPoyle).
  - 2. Ressler Construction Co., Inc.; [rcc54@yahoo.com](mailto:rcc54@yahoo.com) (John Ressler).

3. deGruchy Masonry, Inc.; [andydegruchy@comcast.net](mailto:andydegruchy@comcast.net).
4. Joseph Dugan, Inc.; [info@josephduganinc.com](mailto:info@josephduganinc.com).
5. Masonry Preservation Group, Inc.; [jhappold@mpgnj.com](mailto:jhappold@mpgnj.com) (Jay Happold).
6. Materials Conservation Co., LLC; [bcornish@mccollab.com](mailto:bcornish@mccollab.com) (Betsy Cornish).
7. Paul's Pointing, Inc. [paulspointing@verizon.net](mailto:paulspointing@verizon.net) (Paul Steiner).
8. Witmer Masonry, dba Witmer Restoration, Inc.; [rderr@thewitmergroup.com](mailto:rderr@thewitmergroup.com) (Richard Derr).
9. Eagle Ridge Contracting; [dhowerter@tds.net](mailto:dhowerter@tds.net) (Dave Howerter).
10. A. Raimondo, Inc.; [masonry@raimondo.net](mailto:masonry@raimondo.net) (Nicholas Raimondo).
11. Keystone Waterproofing, Inc.; [john@keystonewp.com](mailto:john@keystonewp.com) (John Thiry).
12. D.A. Nolt, Inc.; [rich@danolt.com](mailto:rich@danolt.com) (Rich O'Brien).
13. Caretti Restoration & Preservation Services, LLC; [gness@carettirestoration.com](mailto:gness@carettirestoration.com) (Gregory Hess).

#### 1.14 PREQUALIFIED RESTORATION SPECIALISTS – STONE CLEANING

- A. Subject to compliance with requirements, provide stone restoration by one of the following.
- B. All stone cleaning specified in Section 040141 "Cleaning of Stone Assembles" must be provided by one of the following masonry restoration specialists, or another firm as reviewed and approved by the Client Agency:
  1. Fairmount Park Conservancy; [tmcoyle@fairmountparkconservancy.org](mailto:tmcoyle@fairmountparkconservancy.org) (Tom McPoyle).
  2. Ressler Construction Co., Inc.; [rcc54@yahoo.com](mailto:rcc54@yahoo.com) (John Ressler).
  3. deGruchy Masonry, Inc.; [andydegruchy@comcast.net](mailto:andydegruchy@comcast.net).
  4. Joseph Dugan, Inc.; [info@josephduganinc.com](mailto:info@josephduganinc.com).
  5. Masonry Preservation Group, Inc.; [jhappold@mpgnj.com](mailto:jhappold@mpgnj.com) (Jay Happold).
  6. Materials Conservation Co., LLC; [bcornish@mccollab.com](mailto:bcornish@mccollab.com) (Betsy Cornish).
  7. Paul's Pointing, Inc. [paulspointing@verizon.net](mailto:paulspointing@verizon.net) (Paul Steiner).
  8. Witmer Masonry, dba Witmer Restoration, Inc.; [rderr@thewitmergroup.com](mailto:rderr@thewitmergroup.com) (Richard Derr).
  9. Eagle Ridge Contracting; [dhowerter@tds.net](mailto:dhowerter@tds.net) (Dave Howerter).
  10. A. Raimondo, Inc.; [masonry@raimondo.net](mailto:masonry@raimondo.net) (Nicholas Raimondo).
  11. Keystone Waterproofing, Inc.; [john@keystonewp.com](mailto:john@keystonewp.com) (John Thiry).
  12. D.A. Nolt, Inc.; [mark@danolt.com](mailto:mark@danolt.com) (Mark Eveland).
  13. Caretti Restoration & Preservation Services, LLC; [gness@carettirestoration.com](mailto:gness@carettirestoration.com) (Gregory Hess).

#### 1.15 EXISTING CONDITIONS PHOTOGRAPHS SHOWING SENSITIVE AREAS

- A. The photographs are examples and not all inclusive.



*Photograph 1 Ornamental chandelier, terrazzo floor, travertine wall and walnut veneer wall panels at Lobby M115.*



Photograph 2 *William Penn Statue at Memorial Hall M114 (to remain in place).*



*Photograph 3 Northeast corner of Memorial Hall 114 showing examples of terrazzo floors and travertine outside corners to be protected.*



*Photograph 4 Escalators 3 and 4, as well as the other four escalators, have been recently modernized. The escalators shall not be used by construction personnel.*





*Photograph 5 Walnut veneer paneling and terrazzo floors at the Ground Floor.*



*Photograph 6 Aircraft at the Second Floor Industry and Technology Exhibit, which must be removed and reinstalled by the .1 General Contractor to permit ACM abatement.*



*Photograph 7 Maragliotti Mural on west wall of second floor of Memorial Hall.*

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 016200

## SECTION 016400

### CAPITOL COMPLEX SECURITY PROGRAM AND CONTRACTOR REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 DGS SECURITY PROGRAM FOR THE CAPITOL COMPLEX

- A. Purpose: The purpose of the security program is to establish policy and procedures for contractor access to the Capitol Complex and other state office buildings. The policy and procedures outlined in this directive will enable contractors to gain safe access to buildings identified in the contract documents.
- B. Scope: This security program applies to all Commonwealth employees and contracted personnel under the Governor's jurisdiction and those employed by independent agencies as well as other individuals and organizations with offices or work locations in the Capitol Complex and other state office buildings.
- C. Definitions: For purposes of this security program, the following words and phrases shall be defined as:
  - 1. Biometric Reader: A device that reads the electronic encryption on an access card and makes an automatic non-invasive assessment of a unique body feature whereby access control systems may be activated.
  - 2. Building Maintenance Spaces: Data closets; air handling equipment rooms; major electrical and building services spaces.
  - 3. Core Buildings: Capitol Building (including the Main Capitol Building and its East Wing); Ryan Building; North Office Building; Speaker K. Leroy Irvis Building; connecting tunnels.
  - 4. Capitol Complex: Core buildings plus Forum Building, Finance Building, Health and Welfare Building, Labor and Industry Building, Keystone Building, Northwest Office Building, Judicial Center, Rachel Carson Building, Strawberry Square and State Museum.
  - 5. Other State Office Buildings: Department of Agriculture; DGS Annex Complex (formerly the Harrisburg State Hospital complex); DGS Public Works at 18<sup>th</sup> and Herr Streets; DGS at 22<sup>nd</sup> and Forster Streets; Harrisstown #1, Harrisstown #2, Commonwealth Tower; Philadelphia, Pittsburgh, Scranton and Reading state office buildings.
  - 6. Capitol Police Security Administration: The Capitol Police Security Administration under the Superintendent of the Capitol Police is responsible for establishing procedures for issuance of photo identification badges and photo identification access badges. The Capitol Police Security Administration produces photo identification badges and photo identification access badges, including the "Emergency Response" designation and maintains photo identification access badge permissions.
  - 7. Card Reader: A device that reads the electronic inscription on an access badge whereby locks or other access control systems may be activated.
  - 8. DGS: Department of General Services.
  - 9. Emergency Response Designation: A red banner with "Emergency Response" printed on the photo identification access badge or a photo identification badge. This designation is determined by the agency and allows the individual access to state offices during an emergency.

10. Photo identification access badge: A card with an employee's photograph, name and department programmed to permit access through use of a card reader or a photo identification badge programmed to permit access through the use of a card reader.
  11. Photo Identification Badge: A card with the individual's photographs, name and association issued to a registered lobbyist, the employee of a contractor or credentialed press for presentation at a visitor entrance.
- D. Policy and Procedures for Contracted Personnel: The following policy and procedures are in place to ensure that personnel of all contracted firms, companies and associations are approved to perform work or provide services in the Harrisburg Capitol Complex and other secured buildings and premises. This does not include suppliers, visiting vendors or delivery persons who must enter through secured visitor's entrances.
1. Contracted personnel who will be on the premises during the business day (Monday – Friday, 6am-6pm) for less than two weeks will NOT need identification badges, and will be admitted to buildings through the security checks at visitor's entrances. All contracted personnel who will be on the premises for more than two weeks during the business day, or after business hours, on weekends and on holidays, MUST HAVE identification badges and are considered to be prime contracted personnel.
  2. The DGS Bureau of Construction Staff/Construction Manager oversees and coordinates the various phases of work performed by contracted persons (including subcontractors, their subcontractors and suppliers) and insures the general conditions and all requirements of the project are met for the Commonwealth. This includes security related issues for contractor access and compliance with the Request for Criminal History Record Information Act check (CHRIA) performed by the Pennsylvania State Police.
  3. The BOC Staff/Construction Manager will ensure that contracted personnel have complied with the criminal history background check process. Personnel requiring photo identification badges must present a cleared CHRIA report and photo identification to Security Administration before the badge is issued. To cover costs incurred by DGS in processing requests for badges by contracted personnel, a processing fee of \$10.00 for a photo identification badge or \$20.00 for a photo identification access badge must be paid by the Contractor before a badge will be issued. Badges that have been damaged, destroyed, stolen or lost through negligence will be replaced only after payment of a replacement fee of \$25.00 for a photo identification access badge or \$15.00 for a photo identification badge. Payment for badges will be in the form of check or money order payable to the Commonwealth of Pennsylvania.
  4. Scheduling of Photos: BOC Staff/The Construction Manager will advise Capitol Police Security Administration of individuals requiring appointments for photo identification. The BOC Staff/Construction Manager will do all communication regarding photo appointments. If you have any questions, please contact the BOC Staff/Construction Manager.
  5. Badges: The appropriate identification badge will be issued to contracted persons who have a clear CHRIA report. If a CHRIA report reflects a positive criminal history, the Bureau of Police and Safety will make appropriate review and enforce its denial policy where required. Individuals with a background that is deemed a security risk will not be issued an identification badge. The badge will be issued for a one-year period from the date of request on the PA State Police Background Check. Badges subject to renewal will be coordinated in the same manner as new issue badges. A new CHRIA certification and processing fee are required each year. Capitol Police Officers will be required to check expiration dates and decline access to those whose badges have expired dates with no exceptions. All badges must be returned to the Construction Manager at the completion of a project or contract. The Construction Manager must return terminated badges to the Capitol Police Security Administration. The Contractor is responsible for paying the replacement/lost badge fee for any badge not returned at the completion of the project. This will be done by a credit Change Order.

6. CHRIA: To obtain your CHRIA report, access the following website: <https://epatch.state.pa.us>. Fill out the information form and use your credit card. If you have no criminal history, you will receive a clear CHRIA report almost immediately. Click on the control number and then certified form. Print the certified form. Security Administration will only accept the certified form that contains the state seal. If there is a criminal history it will be sent by mail. The CHRIA must be submitted to the BOC Staff/Construction Manager along with the processing fees, and the Construction Manager will submit all information to the Security Administration Office. The BOC Staff/Construction Manager will inform the Contractor when the badge(s) are ready for the Contractor to pick up.
7. All badges must be returned to the BOC Staff/Construction Manager at the completion of a project or contract. The BOC Staff/Construction Manager must return terminated badges to the Capitol Police Security Administration. The employer of contracted personnel is responsible for paying the replacement/lost badge fee, for any badge not returned at the completion of the project.

### 1.3 CONTRACTOR REQUIREMENTS FOR THE SECURITY PROGRAM

- A. Each Prime Contractor shall designate a security coordinator to coordinate security issues with its subcontractors and the BOC Staff/Construction Manager.
- B. The security program must be maintained throughout the construction period until final completion.
- C. For new badges, the CHRIA must be submitted to the BOC Staff/Construction Manager 48 hours prior to the scheduled photo appointment; for renewals, no less than 24 hours prior to the individual starting work on the project. Upon submittal of the CHRIA, the security coordinator must inform the BOC Staff/Construction Manager as to the DGS Project Name and No. their personnel will be working on.
- D. The security coordinator for each prime contractor must contact the BOC Staff/Construction Manager to coordinate and schedule an appointment to obtain photo identification badges for all of their employees as well as the employees of sub-contractors or suppliers.
- E. All employees shall display the photo identification badge at all times.

### 1.4 ACCESS TO OCCUPIED/SECURED AREAS REQUEST

- A. All Contractors' employees must have an approved written request for access to all occupied/secured areas of a building. Employees who enter areas other than those designated on the approved written request will be immediately escorted from the site and will not be permitted to return.
- B. Contractors are not allowed to work in buildings outside regular hours without authorization from the Client Agency. Requests must be made 48 hours in advance. Contractors are not allowed to be in the building unless the Client Agency is present as approved by the Client Agency.
- C. The following procedures are presented to establish a consistent and trackable method for the request and authorization of access for occupied/secured areas in the Capitol Complex. The intent is to streamline the process to minimize construction delays and to inform the Client Agencies and Security Agencies of contractor activity in a timely manner. All access requests will be processed through the Construction Manager. The Request for Access procedure established is outlined below:

1. The "Request for Access to Occupied/Secured Areas" form should be fully completed by the Contractor and faxed/emailed to the Construction Manager. This request is to be made no later than 72 hours prior to the requested access date (see Attachment #1).
2. Upon receiving the request from the Contractor, the Construction Manager will request approval from the affected Client Agency and/or Security Agency.
3. The notification of approval will be made via fax or email transmission to the Contractor and DGS once received from the Client Agency and Security Agency. Denials will be communicated to the Contractor via phone, fax and email to explain the reason for the denial and to re-schedule the access.
4. Cancellation of access by the Contractor must be submitted to the Construction manager in writing at least (8) eight hours prior to the start time.

#### 1.5 DELIVERY NOTIFICATIONS

- A. All Contractors' employees must have written notification to deliver goods and/or services to the Capitol Complex. Employees who attempt to deliver items without prior notification may be denied access to the delivery area and may not be permitted to return until written notification has been submitted.
- B. The following procedures are presented to establish a consistent and trackable method for the notification of the delivery of goods and services to the Capitol Complex. The intent is to streamline the process to minimize construction delays and to inform the Client Agencies and Security Agencies of contractor activity in a timely manner. All delivery notifications will be processed through the BOC Staff/Construction Manager. The Delivery Notification procedure established is outlined below:
  1. The "Delivery Notification" should be completely filled out by the Contractor and faxed or emailed to the BOC Staff/Construction Manager. This request is to be made not later than 24 hours prior to the requested delivery (see Attachment #2).
  2. Upon receiving the notification from the Contractor, the BOC Staff/Construction Manager will notify the Security and Client Agency. The contractor should ensure the delivery driver has a copy of the delivery notification at the time of delivery.

#### 1.6 UTILITY SHUTDOWN REQUESTS

- A. All Contractors' employees must have written approval for a Utility Shutdown in any area involving the Capitol Complex.
- B. The following procedures are presented to establish a consistent and efficient method for the request and approval of a utility shutdown to services at the Capitol Complex. The intent is to streamline the process to minimize construction delays and to inform the Client Agencies and Security Agencies of contractor activity in a timely manner. All utility shutdown requests will be processed through the BOC Staff/Construction Manager. The utility shutdown procedure established is outlined below:
  1. The "Request for Utility Shutdown" should be completely filled out by the Contractor and faxed or emailed to the BOC Staff/Construction Manager. This request is to be made no later than two (2) weeks prior to the requested shutdown (see Attachment #3).
  2. Upon receiving the shutdown request from the Contractor, the BOC Staff/Construction Manager will request approval from the affected Client Agency and/or Security Agency.

3. The notification of approval will be made via fax or email transmission to the Contractor and DGS once received from the Client Agency and/or Security Agency. Denials will be communicated to the Contractor via phone, fax and email to explain the reason for the denial and to re-schedule the shutdown.
4. Cancellation of shutdown by the Contractor must be submitted to the BOC Staff/Construction manager in writing at least eight (8) hours prior to the start time. Failure to notify the BOC Staff/Construction Manager may result in back charges to the contractor via credit change order for overtime fees expended by state personnel that may be scheduled to work solely due to the requirements of the contractor shutdown.
5. A shutdown coordination meeting is required with all shutdown requests. The Construction Manager will coordinate this meeting between the Contractor, subcontractors, vendors, suppliers, Client Agencies and/or Security Agencies.

## 1.7 HOT WORK PERMITS

- A. A construction fire can be the single most devastating event to affect a project. Contractor's employees must be thoroughly briefed and familiar with the applicable practices of the National Fire Protection Association.
- B. Any hot work being performed requires the Contractor to complete a hot work request using the "24 Hour Notice Fire/Safety Work Permit" form. A separate request is necessary for each area where hot work is being performed. Upon DGS Fire/Safety approval, the Contractor can perform hot work as indicated on the request. The Contractor is required to have a copy of the signed "24 Hour Notice Fire/Safety Work Permit" form at the location of hot work.
- C. The DGS Fire/Safety personnel will periodically check the job during the shift for conformance to the hot work request; any individual not in compliance with the request will be removed from the project. The Contractor performing this work shall be totally responsible, legally and financially, for any damage that may occur as a result of this work. The procedure for acquiring a hot work permit is outlined below:
  1. The Contractor will request and receive the "24 Hour Notice Fire/Safety Work Permit" form electronically from the Construction Manager (see Attachment #4). This is an electronic PDF form with dropdown boxes to make selections. The contractor will be required to complete this form electronically.
  2. All Contractors must have an approved "24 Hour Notice Fire/Safety Work Permit" form prior to performing any hot work.
  3. A "24 Hour Notice Fire/Safety Work Permit" form is required under the following hot work descriptions:
    - a. Chemical Use
    - b. Cooking
    - c. Cutting
    - d. Grinding
    - e. Insulation
    - f. Ladder Work
    - g. Painting
    - h. Restoration
    - i. Sandblasting
    - j. Soldering
    - k. Static Displays
    - l. Sterno
    - m. Welding
    - n. Other Contact Fire/Safety with Explanation



4. Upon fully completing the "24 Hour Notice Fire/Safety Work Permit" form, the Contractor shall email to the Fire and Safety Agency ([gs-firesafetyenv@state.pa.us](mailto:gs-firesafetyenv@state.pa.us)) and copy the DGS Bureau of Construction and the Construction Manager, with at least a 24 hour period before the hot work commences. The Fire and Safety Agency will either approve or advise if other requirements are necessary and email back to contractor, DGS Bureau of Construction and the Construction Manager.
5. Contractor must comply with all instructions on the form and the checklist. They must have the form in their possession while performing the hot work.
6. Hot work must be completed 60 minutes before fire watch is conducted by Contractor who has done the hot work. Contractor must provide an email reporting time of completion of work and time of fire watch and results to DGS and the Client Agency.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION 016400

**Attachment #1**  
January 16, 2009

**Request for Access to Occupied/Secured Areas**

Date: [redacted] DGS Project No.: [redacted]

Contractor: [redacted] Subcontractor (if applicable): [redacted]

Point of Contact: [redacted]

Phone/Cell/Pager: [redacted]

Building: [redacted]

Room No(s): [redacted]

Date(s) of Proposed Access: [redacted]

ExactTime(s) of Proposed Access: [redacted]

Scope of Work to be Performed/Crew Size:

[redacted]

Hot work will be performed during this access: YES  NO

**COMPLETE FORM AND FAX OR EMAIL TO CONSTRUCTION MANAGER (CM)**

CM Contact Person: \_\_\_\_\_

CM Contact Fax: \_\_\_\_\_

CM Contact Email: \_\_\_\_\_

CM Contact Phone: \_\_\_\_\_

Do not write below this line – for Department of General Services Use Only  
.....

**If this access is acceptable, please sign below and this approval will be sent to all contractors requiring access. If there are modifications to this schedule, please note accordingly and we will distribute. Thank you in advance for your assistance.**

Authorizing signature and date: [redacted]  
(email response is acceptable)

**Attachment #2**  
January 16, 2009

**Delivery Notification**

Date: \_\_\_\_\_ DGS Project No.: \_\_\_\_\_

Contractor: \_\_\_\_\_ Subcontractor (if applicable): \_\_\_\_\_

Point of Contact: \_\_\_\_\_

Phone/Cell/Pager: \_\_\_\_\_

Driver: \_\_\_\_\_ Badge: Yes  No

Vehicle year, make, model and color: \_\_\_\_\_

License Plate No.: \_\_\_\_\_

Exact Time(s) of Proposed Delivery: \_\_\_\_\_

Date of Proposed Delivery: \_\_\_\_\_

Where Delivery will take place: \_\_\_\_\_

Who will receive Delivery/Contact info: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**COMPLETE FORM AND FAX OR EMAIL TO CONSTRUCTION MANAGER (CM)**

CM Contact Person: \_\_\_\_\_

CM Contact Fax: \_\_\_\_\_

CM Contact Email: \_\_\_\_\_

CM Contact Phone: \_\_\_\_\_

**Attachment #3**  
January 16, 2009

**Request for Utility Shutdown**

**Date:** [redacted]                      **DGS Project No.:** [redacted]

**Contractor:** [redacted]                      **Subcontractor (if applicable):** [redacted]

**Point of Contact:** [redacted]

**Phone/Cell/Pager:** [redacted]

**Utility Proposed for Shutdown:** [redacted]

**Date and Time Shutdown is Proposed to Start:** [redacted]

**Date and Time Restart is Proposed:** [redacted]

**Specific Area(s) to be Affected:** [redacted]  
(Identify Room Nos. from floor plans included and no contract drawings)

**Justification for Shutdown Request:**  
[redacted]

**COMPLETE FORM AND FAX OR EMAIL TO CONSTRUCTION MANAGER (CM)**

**CM Contact Person:** \_\_\_\_\_

**CM Contact Fax:** \_\_\_\_\_

**CM Contact Email:** \_\_\_\_\_

**CM Contact Phone:** \_\_\_\_\_

This Section to be completed by the Construction Manager (CM)

**Request sent to (DGS Contact/Date):** [redacted]

**Deadline for Response to CM:** [redacted]

Do not write below this line – for Department of General Services Use Only

**DGS Authorizing signature and date:** [redacted]

**DGS Rejection signature and date:** [redacted]

**Attachment #4**  
January 16, 2009

**\*\*24 HOUR NOTICE \*\***  
**FIRE/SAFETY WORK PERMIT**

<b>Date of Request:</b>		<b>Work Order # DGS Project #</b>	
<b>Building:</b>		<b>Floor:</b>	
<b>Exact location:</b>			
<b>Exact Work Description: ( Note ) Select From Drop down List WELDING</b>			
<b>Exact Location:</b>			
<b>CONTRACTOR / AGENCY:</b>			
<b>Date of Work:</b>	<b>Start Time:</b>	<b>Finish Time:</b>	
<b>PERSON CONDUCTING WORK:</b>		<b>Fire Watch:</b>	
<b>SUPERVISOR:</b>		<b>Contact Phone #</b>	
<b><u>THE FOLLOWING ITEMS ARE REQUIRED AND MUST BE ADHERED TO ACCORDINGLY OR WORK WILL BE DENIED OR RESCHEDULED</u></b>			
<b>PERSONS CONDUCTING WORK THAT REQUIRES A FIRE/SAFETY PERMIT WILL ABIDE BY THE FOLLOWING:</b>			
<ul style="list-style-type: none"> <li>• Notify the DGS Building Manager and the DGS Fire Safety Office of any intended Hot Work via this form <b>NOT LESS THAN 24 HRS NOTICE UNLESS DEEMED AN EMERGENCY.</b></li> <li>• ONCE THIS FORM IS COMPLETED IT MUST BE SUBMITTED ELECTRONICALLY.</li> <li>• Be responsible for fire protection in the work areas and staging areas</li> <li>• Supply and maintain all necessary fire protection equipment.</li> <li>• Provide a minimum of two APPROVED working fire extinguishers rated at 10 lb. ABC within each Work/Event area 75 ft. apart.</li> <li>• Provide a fire watch at all times while open flame operations are taking place and for one hour after completion of work.</li> <li>• Utilize a flame resistant pad to protect all adjacent surfaces from open flame.</li> <li>• Provide a smoke/dust elimination devices or negative air enclosure at work site.</li> <li>• Not permitted to leave the work area until the materials have reached a temperature where it can be touched with a non-gloved hand.</li> </ul>			
<b>Contact information for DGS Fire Safety Phone (717-772-4545)</b>			
<b>E-Mail to: <a href="mailto:GS-firesafetvenv@state.pa.us">GS-firesafetvenv@state.pa.us</a></b>			
<b>HOT WORK CHECKLIST</b>			
<input type="checkbox"/>	Fire alarm system is disabled or there is no risk of activation.		
<input type="checkbox"/>	The area is swept clean of combustibles.		
<input type="checkbox"/>	All movable combustible items have been moved away from Hot Work area.		
<input type="checkbox"/>	All non-movable combustible flooring, building material, adjacent surfaces are covered with flame Resistant blankets.		
<input type="checkbox"/>	Flame Resistant Pads / Tarpaulins suspended beneath work if working on walls or ceilings.		
<input type="checkbox"/>	Hot Work is being conducted on Non-Combustibles and without Combustible Covering or Insulation.		
<input type="checkbox"/>	Enclosed equipment (If at or adjacent to the Hot Work areas) is cleaned of all combustibles.		
<input type="checkbox"/>	Containers adjacent to Hot Work area purged of ALL Combustible Materials.		
<input type="checkbox"/>	Fire Watch is trained in use of Portable Fire Extinguishers and Sounding the Alarm.		
<b>DISABLED POINT (S) OR LOOP (S)</b>			
<b>Approval date:</b>		<b>Approval Time:</b>	
<b>Date Posted:</b>		<b>Time Posted:</b>	
<b>DGS FIRE / SAFETY APPROVAL:</b>			

## SECTION 017100

### REMOVAL OF ASBESTOS-CONTAINING MATERIALS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.
- B. The procedures specified herein are guidelines for minimum performance. The Contractor is responsible for his own methods of operations and conformance to regulatory codes, rules and guidelines. The Contractor is required to obtain all permits, licenses and approvals to perform the work, including any rights to use patented systems

##### 1.2 SCOPE OF WORK

- A. The scope of work for this Project covers the supplying of all labor, tools, materials, equipment, services, disposal and appurtenances to accomplish the work specified and indicated on the contract drawing. The work shall be performed to the complete satisfaction of the Department in accordance with the current EPA and OSHA regulations, PA Dept. of Labor and Industry and Dept. of Environment Protection regulations and any other applicable Federal, State and Local regulations.
- B. Contractor shall submit an Action Plan which describes specifically how abatement work is to be completed for each abatement phase. At a minimum, the Action Plan shall address work area preparation, work practices, decontamination unit location, estimated completion dates, respiratory protection, and disposal. Approval of the Action Plan must be obtained through the Professional prior to the start of work. Procedures outlined in the Action Plan must be followed throughout the abatement phase. Any changes in Action Plan must obtain prior approval from Professional.
- C. Work under this Project includes, but is not limited to, the following:
  - 1. The following friable Regulated Asbestos-Containing Materials (RACM) and non-friable Class I (NF-1) materials are known to be present at the work site. If any other friable or non-friable materials are found, which are suspected of containing asbestos, notify the Environmental Consultant immediately both verbally and in writing. Do not proceed with any additional work without written approval.
    - a. Acoustical finish on gypsum ceiling plaster.
    - b. 9" x 9" floor tile.
    - c. 9" x 9" floor tile mastic.
  - 2. Materials to be removed and disposed specifically include asbestos-containing acoustical ceiling plaster & 9" x 9" floor tile & mastic from the 1st, 2<sup>nd</sup> and 5<sup>th</sup> floors of the State Museum of PA (SMPA). The project site is located at 300 North Street, Harrisburg, Pennsylvania.
  - 3. As determined during onsite inspections and plans review of the SMPA the following asbestos containing materials are listed with their respective quantities and locations:

- a. 1<sup>st</sup> Floor: Friable asbestos acoustical ceiling finish on gypsum plaster is present. There is approximately 296 sf of acoustical ceiling finish located in the Village Square exhibit M103 and 860 sf in the M112 exhibit area.
- b. 2<sup>nd</sup> Floor: Friable asbestos acoustical ceiling is present. There is approximately 635 sf of ceiling finish located in the Industry/Technology exhibit Area M221.
- c. 4<sup>th</sup> Floor: Friable asbestos acoustical ceiling finish on gypsum plaster is present. There is approximately 270 sf of ceiling finish at Office M426.
- d. 5<sup>th</sup> Floor:
  - 1) Friable asbestos acoustical ceiling finish on gypsum plaster is present. There is approximately 270 sf of ceiling finish located in Room M502; and 1.5 sf from outside-Rooms M500, M502, M506 & M526 combined for a total of 6 sf.
  - 2) There is 270 sf of asbestos containing non-friable 9" x 9" floor tile and mastic in Room M502.

4. The following table lists ACM types and quantities.

#### ACM Totals

Material	Floor	Location	Exhibit/Office	Quantity (sf)	Total
1. Ceiling Finish	1 <sup>st</sup>	M103	Village Square	296	2,337
	1 <sup>st</sup>	M112		860	
	2 <sup>nd</sup>	M221	Industry/Technology	635	
	4 <sup>th</sup>	M426	Office	270	
	5 <sup>th</sup>	M502	Office	270	
	5 <sup>th</sup>	Outside M500	Hallway outside Storage Rm	1.5	
	5 <sup>th</sup>	Outside M502	Hallway outside office	1.5	
	5 <sup>th</sup>	Outside M506	Hallway outside office	1.5	
	5 <sup>th</sup>	Outside M526	Hallway outside office	1.5	
2. 9" X 9" Floor Tile	5 <sup>th</sup>	M502	Office	270	270
3. 9"x9" Floor Tile Mastic	5 <sup>th</sup>	M502	Office	270	270

#### 1.3 CONTROL OF WORK

- A. All work which does not conform to the requirements of the contract, plans and specifications will be considered unacceptable.
- B. Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to the final acceptance of the work, shall be corrected immediately and replaced in an acceptable manner.
- C. All Proposers are encouraged to visit the job site prior to bidding to determine job conditions.
- D. If the Department finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the plans and specifications and have resulted in an unacceptable finished product, the affected work or material shall be removed and replaced or otherwise corrected by and at the expense of the Contractor.

- E. The term "reasonably close conformity" shall not be construed as waiving the Contractor's responsibility to complete the work in accordance with the contract, plans and specifications. The term shall not be construed as waiving the Department's right to insist on strict compliance with the requirements of the contract, plans and specifications during the Contractor's prosecution of the work, when in the Department's opinion and judgment such compliance is essential to provide an acceptable finished work.

#### 1.4 QUALITY ASSURANCE

##### A. Quality Assurance Hazmat Monitoring Firm:

1. The Professional shall contract for a Quality Assurance Hazmat Monitoring firm, hereafter referred to as the 'QA', which specializes in performing air sampling, project monitoring and inspections on asbestos abatement projects. The testing laboratory shall as a minimum be accredited by the NIOSH PAT Program (Proficiency Analytical Testing) for PCM asbestos air analysis, and NVLAP for asbestos bulk analysis.
2. The QA will be responsible for certifying the Project was completed in accordance with all federal, state, and local asbestos standards and regulations.
3. The QA and Asbestos Abatement Contractor must complete the Certification of Visual Inspection form found at the end of this section, for each work area completed.
4. The QA shall review the Contractors Action Plan which describes specifically how work is to be completed for each abatement phase. Approval of the Action Plan must be obtained through the Professional prior to the start of work.

##### B. Contractor Experience:

1. The Asbestos Abatement Contractor shall have a minimum of three (3) years' experience in the asbestos abatement business. He shall have successfully completed three (3) projects of similar or larger size and dollar value to this project and shall not have defaulted on an asbestos abatement project within the last three (3) years. The Contractor shall be certified by Pennsylvania Department of Labor and Industry (PA L&I).

##### C. Worker Certification:

1. The Contractor shall furnish proof that his employees have had instruction on the dangers of asbestos exposure, on respirator use, decontamination and current OSHA and EPA regulations.
2. Documentation of workers medical exams, consist of x-rays and pulmonary function shall be submitted and as may be required by current OSHA and EPA regulations and any applicable Federal, State and Local regulations.
3. There must be on site at all times, an EPA Certified Asbestos Abatement Supervisor. The Asbestos Abatement Supervisor shall have successfully completed a 5-day EPA Certified Practices and Procedures Course as per 40 CFR, Part 763, Subpart E, Appendix C-EPA Model Accreditation Plan (must provide a copy of certificate from EPA approved course). All asbestos workers shall have successfully completed a 4-day EPA Certified Practices and Procedures Course as per 40 CFR, Part 763, Subpart E, Appendix C-EPA Model Accreditation Plan. The Contractor must provide copies of certificates from PADOLI for all workers, and supervisors as required by regulation.
4. When required by the PA L&I the Contractor, Abatement Supervisor, and Abatement Workers shall be licensed by PA L&I. Each worker/supervisor shall have a current photo identification issued by PA L&I available on request by the Department when required.



## 1.5 POSTING OF REGULATIONS

- A. The Contractor will have in his possession, at all times, at his office one (1) copy in view at the job site one (1) copy, current OSHA Regulations 29 CFR 1926.1101, Asbestos and current Environmental Protection Agency 40 CFR Part 6.1, Subpart M: National Emission Standard for Hazardous Air Pollutants as related to asbestos stripping, emissions, notification, work practices and disposal of asbestos waste.

## 1.6 REGULATORY SUBMITTALS (CONTRACTOR'S RESPONSIBILITY)

- A. The Contractor is required to notify the building occupants and the following agencies in writing ten (10) days prior to starting work for notification and instructions concerning proper disposal of asbestos waste material.
  - 1. United States Environmental Protection Agency – Region III  
Asbestos – NESHAP Coordinator (3AT33)  
841 Chestnut Building  
Philadelphia, PA 19106
  - 2. Pennsylvania Department of Environmental Protection  
Bureau of Air Quality Control  
Southcentral Regional Manager
  - 3. Pennsylvania Department of Labor and Industry  
Asbestos Occupation Accreditations & Certification  
Bureau of Occupational and Industrial Safety  
Room 155E Labor and Industry Building  
Seventh & Forster Streets  
Harrisburg, Pennsylvania 17120
- B. Where work is performed in Allegheny County or City of Philadelphia, appropriate notification must also be made. Obtain permits as required by local regulations.
- C. EPA, DEP approved asbestos landfill proposed to be used by the Contractor for RACM. Submit completed WSR for RACM at projects end (see 3.07, F).

## 1.7 AIR TESTING AND MONITORING

- A. Air sampling of the work areas and surrounding environment will be conducted during the performance of this Contract by the QA, so as to ensure abatement procedures are in compliance with all codes, regulations, ordinances and this specification.
- B. The Contractor shall fully cooperate with the QA and all others responsible for testing and inspecting the work.
- C. Air testing and analyses shall be in accordance with current EPA and requirements of Section 29 CFR 1926.1101 of the current OSHA Regulations, as a minimum. Analysis shall be performed by Phase Contrast Microscopy per NIOSH 7400 Method and/or Transmission Electron Microscopy (TEM) per AHERA analytical procedures.
- D. Air tests taken prior to start of work (background) and at completion (pre-clearance) will be analyzed by PCM-Phase Contrast Microscopy. Final (clearance) testing shall be by TEM-Transmission Electron Microscopy.

- E. The QA shall give verbal notification to the Department of the results of each test within twenty-four (24) hours of the time the samples were delivered to the laboratory. The QA shall confirm the results in writing within three (3) days thereafter. A microscope on site for PCM analyses is acceptable to facilitate a faster turn-around time.
- F. Prompt reports are necessary so that, if required, modifications to work methods and/or practices may be implemented as soon as possible.
- G. Representatives of the QA shall have access to the work area at all times. The Contractor shall provide facilities for such access in order that the QA may properly perform its function.
- H. Sampling equipment and personnel will be provided by the QA.
- I. Air sampling will be performed by the QA in each work area prior to commencement of the work at that location. The highest fiber count reading during pre-clearance clean-up monitoring shall be lower than the background readings established by pre-job monitoring or 0.01 fibers per cubic centimeter (f/cc), whichever is lower. When the criteria is met, perform final clearance testing by Transmission Electron Microscopy (TEM) using AHERA methodology. Clearance criteria is 70 s/mm<sup>2</sup> for fibers greater than .5 microns in length with an aspect ratio 5:1.
- J. Air samples will be taken by the QA in accordance with, but not necessarily limited to, the following schedule:

AREA	WHEN	NUMBER	MINIMUM VOLUME (liters)	FLOW RATE (liters/min.)
Work Area (PCM)	Prior to job start	2	1500	2-10
Work Area (PCM)	During area isolation	Daily <sub>1</sub>	480-960	1-2
Work Area - Inside (PCM)	During abatement work	Daily <sub>1</sub>	480-960	1-2
Work Area – Exterior (PCM) <sub>2</sub>	During abatement work	Daily <sub>1</sub>	1000	2-10
Work Area (PCM) <sub>3</sub>	Upon work (pre-clearance) completion	2 (minimum)	1000	2-10

Schedule Notes:

- 1 Consecutive daily air samples will be collected for the duration of the work shift for each active work area.
- 2 Exterior work area(s) samples shall be collected daily at decon clean room entrance, load out exit, discharge of HEPA exhaust units, and area(s) adjacent to work area(s) that are occupied or will be re-occupied.
- 3 Aggressive air sampling must be conducted when work area is prepared as a negative pressure enclosure.

- K. Work area clearance testing shall be completed before work site protective barriers are removed.
- L. The Contractor is responsible for performing the thirty (30) minute excursion air sampling per OSHA regulations.
- M. The Contractor is responsible for performing 8 hour TWA personal air samples in the employees breathing zone per OSHA regulations.

1.8 AIR FILTERING (FOR GUIDELINE PURPOSES ONLY)

- A. An approved negative pressure machine may be used in the active work area using HEPA equipped air movement units.
- B. Air may be drawn from clean areas through the decontamination and active work areas, HEPA filtered and exhausted through air movement units to the containment exterior. Replace filters in accordance with manufacturer's instructions and to meet the needs of this specification.
- C. Air movement should be sufficient quantity to ensure a minimum of four (4) air changes per hour.

Example: Active work area = 50' x 50' x 20' H = 50,000 cu. Ft.  
for four air changes per hour = 4 AC/HR x 50,000 CF/AC = 200,000 cu.ft./hr.  
In cubic feet per minute = 200,000 CF/HR : 60 min/hr = 3,333 cu. ft./minute

This active work area would require a combination of air movement/HEPA units, i.e., 2,500 CFM and 1,500 CFM

- D. The exhaust system must be sufficient to maintain a minimum pressure differential of -0.02 inches of water relative to unsealed, adjacent area. Provide continuous, twenty-four (24) hours per day monitoring of the pressure differential with an automatic recording instrument
- E. The exhaust system(s) shall run twenty-four (24) hours/day until final clearance is obtained and will be maintained in accordance with ANSI Z9.2 and the manufacturer's directions.
- F. To ensure continuous operation, Contractor shall have a spare negative exhaust unit available.

1.9 ALTERNATIVE AIR FILTERING METHODS

- A. Other approved air filtering methods may be utilized at the Contractor's discretion, with the stipulation that designated regulatory agencies provide documented approval to the Department. It shall be the responsibility of the Contractor to submit all documentation required to the appropriate regulatory agency for their review and approval.

1.10 PLACEMENT OF WARNING SIGNS AND LABELS

- A. The Contractor shall furnish and place warning signs at all approaches to asbestos control areas containing concentrations of airborne asbestos fibers. Locate warning signs at such a distance that personnel may read the warning sign and take the necessary protective action required before entering the area. Warning signs shall be in place for the duration of the work. The Contractor shall furnish and attach caution labels to all disposal containers holding asbestos materials, scrap waste, debris and other products contaminated with asbestos.
- B. Warning Signs: Provide warning signs conforming to 29 CFR 1926.1101 with the following legend:

**DANGER**  
**ASBESTOS**  
**CANCER AND LUNG DISEASE HAZARD**  
**AUTHORIZED PERSONNEL ONLY**  
**RESPIRATORS AND PROTECTIVE CLOTHING ARE**  
**REQUIRED IN THIS AREA**

- C. Caution Labels: Attach label to the outside of all disposal bags and containers which hold asbestos contaminated materials and are to be removed from the site. Caution labels shall be printed in letters of sufficient size and contrast so as to be readily visible and legible and shall display the following legend:

**DANGER**  
**CONTAINS ASBESTOS FIBERS**  
**AVOID CREATING DUST**  
**CANCER AND LUNG DISEASE HAZARD**

- D. Identification Labels: Attach label to the outside of all disposal bags and containers which hold asbestos contaminated materials and are to be transported off facility site. Identification labels shall display the following legend:

Waste Generator Name: \_\_\_\_\_ Fill Out \_\_\_\_\_

Generator Location: \_\_\_\_\_ Fill Out \_\_\_\_\_

- E. Transportation marking shall conform to 49 CFR 171 and 172 and shall be provided on all containers with more than one pound of friable asbestos. Transportation marking shall display the following legend:

**R Q HAZARDOUS SUBSTANCE**  
**SOLID, NOS**  
**ORM-E, NA 9188**  
**(ASBESTOS)**

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT AND MATERIALS

- A. The list of required materials will include, but is not necessarily limited to, the following:
1. Respirators: Provide respiratory protection in accordance with OSHA Regulation 29 CFR 1926.1101 and appendices ANSI Z88.2-1980. Respiratory protection regardless of negative exposure assessments. There shall be no exception to this requirement. As minimum protection, negative pressure air purifying respirators shall be worn. Contractor shall select the appropriate respirator based on an initial exposure assessment or exposure monitoring results. No employee or visitor shall enter any area without this protection until clearance has been obtained. Employees or visitors shall wear a respirator. Respirators shall be NIOSH approved. Ensure proper filters are worn using a HEPA as a minimum.
  2. Protective Clothing: Disposable Clothing, such as "Tyvek" by DuPont. Clothing shall consist of coverall, head cover and foot cover. Gloves will be worn for hand cover as needed.
  3. Wetting Agents: The asbestos material will be sprayed with water containing an additive to enhance penetration. The additive, or wetting agent, will be polyoxyethylene at a concentration of one (1) ounce per five (5) gallons of water or as otherwise specified by manufacturer. A fine spray of this solution must be applied to prevent fiber disturbance preceding the removal of the asbestos material. The asbestos will be sufficiently saturated to prevent emission of airborne fibers in excess of the exposure limits prescribed in the current OSHA standards referenced in these specifications. DRY REMOVAL WILL NOT BE ALLOWED EXCEPT WITH WRITTEN APPROVAL FROM EPA or BECAUSE OF FREEZING WORK AREA TEMPERATURES.

4. Polyethylene Sheeting: Six (6) mils, for protection of floors, walls, doors, windows, fixed equipment, HVAC supply and return openings, and critical barriers.
5. Polyethylene Bags (with warning labels) six (6) mils minimum for disposal. All asbestos that is removed shall be double bagged.
6. Tape: High quality vinyl or fabric duct tape. Paper masking tape will not be permitted.
7. Negative Pressure Filtration Equipment: Air movement and filtering equipment equipped with HEPA filters rated at 99.97% removal down to 0.3 microns, and of sufficient capacity to provide a minimum of four (4) air changes per hour for each active work area.
8. Airless Spray Equipment: Electric airless spray equipment for saturating and mist fiber control. Low pressure (500 psi) equipment must be available on-site and utilized as required.
9. Vacuum: HEPA rated for surface cleaning and house-keeping. Hand operated and power tools such as, but not limited to, saws, corers, abrasive wheels and drills should be provided with local exhaust ventilation systems with HEPA filters.
10. Hand Tools: Brooms, plastic shovels, scrapers, brushes, etc., in sufficient quantity to ensure the appropriate level of housekeeping.
11. Water Filtration System: Shower and contaminated water filtration system.
12. GFI Equipment: All electrical connections in the work area must be through "ground fault" protected outlets/circuits.
13. Penetrating Encapsulant: Penetrating encapsulants to be used on this project are International Cellulose Corporation SK-13 Asbestos Encapsulant, International Protective Coatings Corporation Serpiflex Shield, Fiberlock Technology ABC Asbestos Binding Compound Concentrate, and others listed as acceptable in the Environmental Protection Agency - Battelle Laboratory Encapsulant Study, or approved equal.
14. Bridging Encapsulant: Bridging encapsulants to be used on this project are American Coatings Corporation Cable Coating 2B, Decadex Laboratories Firecheck, Fiberlock Technology ABC Asbestos Binding Compound Concentrate, or approved equal

- B. The Contractor will have at all times in his possession at the job site Material Safety Data Sheets (MSDS) for wetting agents, encapsulants, solvents, strippers, and any other potentially hazardous materials.

## 2.2 PERSONNEL PROTECTIONS

- A. Personnel protection is required for laborers, mechanics, supervision and visitors at the work site during the set-up and abatement operations.
- B. Each worker shall be supplied with a minimum of two (2) complete protective work clothes and respirator filter changes per day for the complete duration of the project. Hard hats should be available as appropriate which meet ANSI Z-89.1 standards. Safety toe footwear is to be worn underneath the disposable shoe covers and must meet the requirements and specifications in ANSI Z-41.1. Eye wear and face protection must meet the standards and specifications of ANSI Z-87.1.
- C. In addition to sets of protective work clothes for workers, the Contractor shall have on hand two (2) additional sets of disposable work clothes, per day and respirators for personnel who are authorized to inspect the work site. Hard hats should be available as appropriate which meet ANSI Z-41.1. Eye wear and face protection must meet the standards and specifications of ANSI Z-87.1.
- D. Respirators approved for asbestos use and protective work clothes will be worn by laborers and mechanics as a minimum during set-up operations (plastic draping, light-fixture dropping or removal, etc.).
- E. Appropriate respirators will be worn by all personnel in the active work area.

- F. Upon leaving the active work area, filters will be discarded, cartridges removed and respirators cleaned in disinfectant solution and clean water rinse.
- G. Clean respirators will be stored in plastic bags when not in use.
- H. Respirators will be inspected daily for broken, missing, or deteriorated parts.

## PART 3 - EXECUTION

### 3.1 AREA PREPARATION

- A. Movable furniture, blinds and equipment will be removed from area of work by the Contractor.
- B. Heating and ventilating system servicing the areas of work must be shut down prior to starting any work. Notify the Institution prior to starting any work in order that they may arrange to have the heating and ventilating system shut down.
- C. The Contractor shall isolate the work area for the duration of the work by installing critical barriers completely sealing off all openings in the work area, including, but not limited to, heating, ventilation ducts, doorways, corridors, windows, roof ventilator openings, and wall vents, with plastic sheeting taped securely in place with six (6) mils plastic sheeting.
- D. The Contractor shall build decontamination chamber(s) to be connected to each active work area for entrance to or exit from the active work area. When required a separate material load out unit shall be constructed.
- E. All floor and wall surfaces in the work areas shall be covered with plastic sheeting taped securely in place to protect them from water damage and asbestos contamination.
- F. The Contractor shall cover all fixtures, fixed demountable partitions, lighting, fixed items and equipment in the work area with plastic sheeting taped securely in place.
- G. Duct tape, staples, wood strips and other methods will be used appropriately to attach vertical plastic barriers to walls and to floors. All edges of plastic material shall overlap the adjoining sheet a minimum of twelve inches. All joints (vertical and horizontal) to be continuously sealed with duct tape.
- H. Upon completion of area isolation, the Contractor shall remove, where practical, all detachable electrical heating and ventilation equipment, wipe and vacuum, clean and remove from active work area.

### 3.2 DECONTAMINATION UNIT (USAGE AND ACTIVITIES)

- A. Outside room (clean room): In this room the worker leaves all street clothes and dresses in clean working clothes (usually disposable coveralls). Respiratory protection equipment is also stored in this area. No asbestos contaminated items should enter this room. Workers enter this room either from outside the structure dressed in street clothes, or naked from the showers, after showering.
- B. Shower Room: This is a separate room used for transit by cleanly dressed workers entering the job from the outside room or by workers headed for the showers after undressing in the equipment room.

- C. Equipment Room (contaminated area): Work equipment, footwear, additional contaminated work clothing are left here. This is a change and transit area for workers.
- D. Decontamination chambers require temporary services. Verify during bidding period the availability for temporary hook up. Mobilization, hook-up and demobilization, disconnection costs will be the responsibility of the Contractor. Installation of temporary services during demolition shall be per current EPA and OSHA regulations.
- E. Work Area: The work area should be separated by polyethylene barriers from the equipment room. If the airborne asbestos level in the work area is expected to be high, as in dry removal an additional intermediate cleaning space may be added between the equipment room and the work area. Isolation of the work areas, as required, is necessary to prevent contamination and fiber dispersal to other areas of the building during work and clean-up operation. Air movement will flow uninterrupted from outside the work area through the change and equipment rooms and into the active work area. It is then HEPA filtered and exhausted to the building exterior.

### 3.3 WORK AREA ENTRANCE/EXIT

- A. All workers involved in the removal of asbestos will utilize the following procedure for work area entrance and exit.
- B. The worker enters the outside room and removes clothing, puts on clean coveralls, gloves and respirator. Protective clothing sleeves will be taped to gloves and protective clothing legs will be taped to foot covers. The neck collar, zipper seam, wrists and ankles of protective clothing will be taped closed.
- C. Worker proceeds via shower room to equipment room. Any additional clothing and equipment left in equipment room and required by worker is put on. This includes additional warm garments workers usually provide themselves when the work area is too cold for coveralls only. These must be treated as contaminated clothing and left in the decontamination area.
- D. Worker proceeds to work area.
- E. Before leaving the work area, the worker should remove all gross contamination and debris from the protective clothing, by vacuuming down the clothes with a vacuum cleaner with a HEPA filter. In practice, this is carried out by one worker assisting another.
- F. The worker proceeds to equipment room and removes all clothing except respiratory protection equipment. Extra work clothing may be stored in contaminated end of the area.
- G. Disposable protective clothing is placed in a bag for disposal. The worker then proceeds into the shower room. Respiratory protection equipment should only be removed after wetting in shower to prevent inhalation of fibers. Ensure that employees shower every time upon exiting the work area and before entering the clean room.
- H. After showering, the worker moves to the clean room and dresses in either new protective clothes for another entry, or street clothes if leaving. Respirator filters are sealed with tape or thrown away if spent, and respirator body is thoroughly cleaned and brought to the clean room.
- I. Workers shall not eat, drink, smoke, chew gum, or chew tobacco in the work area. To eat, drink or smoke, workers shall exit the work area following the decontamination procedure outlined above.
- J. All footwear shall be left inside work area until completion of the job, then cleaned or discarded.

### 3.4 METHOD OF REMOVAL

- A. Remove and dispose of all asbestos-containing materials (ACM) in accordance with the methods and procedures outlined in the United States Department of Labor, Occupational Safety and Health Administration (OSHA) Asbestos Regulations, Codes of Federal Regulations Title 29, Part 1926, Section 1926.1101.
- B. Dry removal will not be allowed except when wet removal will create a safety hazard. Dry removal process will require written authorization by EPA and the Department except when work area has freezing conditions.
- C. Work of this section shall be performed in the following manner:
  - 1. Eliminate air flow into containment area by isolating all supply and return air ducts from mechanical system. Turn off electrical power.
  - 2. Install six (6) mil polyethylene critical barriers over all doors, wall openings, ceiling openings, electrical outlets, etc. Secure with duct tape on all sides.
  - 3. Six (6) mil polyethylene protecting ceiling surface from wall to wall.
  - 4. Six (6) mil polyethylene protecting wall surface from floor to ceiling.
  - 5. Isolation barriers separating occupied areas and work areas shall be framed and covered with 1/2-inch plywood and two (2) layers of six (6) mil polyethylene.
  - 6. Duct HEPA filter unit through door. Locate unit to prevent dead air pockets.
  - 7. Install triple air curtain, six (6) mil polyethylene (typical), over door opening into decontamination unit or load out unit.

### 3.5 HOUSEKEEPING

- A. Throughout the work period, the Contractor shall maintain the building and site in a standard of cleanliness as specified throughout these specifications.
- B. Contaminated disposable clothing, respirator filters and other debris will be bagged, properly labeled and sealed at the end of each work day.
- C. All asbestos generated by either removal, encapsulation or repair will be bagged, properly labeled, and sealed at the end of each work day.
- D. Respirators will be thoroughly cleaned at the end of each work day and stored for the next day's use.
- E. Retain all stored items in an orderly arrangement allowing maximum access, not impeding traffic, and providing the required protection of materials.
- F. Do not allow the accumulation of scrap, debris, waste material, and other items not required for completion of this work.
- G. At least weekly, and more often if necessary, completely remove all scrap, debris and waste material from the job site.
- H. Unless otherwise noted or directed, materials resulting from demolition operations shall be the property of the Contractor, shall not be used in the work and shall be promptly removed from the site.
- I. Daily and more often if necessary, inspect the work areas and adjoining spaces, and pick up all scrap, debris and waste material. Remove all such items to the place designated for their storage.



- J. Provide adequate storage for all items awaiting removal from the job site, observing all requirements for fire protection and protection of the ecology.
- K. Maintain the site in a neat and orderly condition at all times.
- L. Compressed air is not to be used for cleaning purposes.

### 3.6 FINAL DECONTAMINATION OF WORK AREA

- A. Following careful double bagging of all removed asbestos material by the Contractor, he shall label bags as required.
- B. Bags shall be wiped with clean damp cloths prior to transportation to approved disposal site.
- C. With critical barriers in place, sheet plastic on walls, floors, and ceiling, the negative pressure system operating, the Contractor shall carry out the first cleaning. If there are two layers of wall, floor, and ceiling plastic, clean outer layer as described below and remove carefully. With one layer of wall, floor, and ceiling plastic in place, use damp cleaning cloth to wipe surfaces of plastic. Use each surface of a cleaning cloth one time and then dispose of as contaminated waste.
- D. Continue this cleaning until there is no visible debris from removed material or residue on plastic sheeting. This first cleaning shall extend to include the Equipment Room (Dirty Room) in the decontamination unit.
- E. Pressure washing techniques of any kind are strictly prohibited.
- F. Pre-Encapsulation Inspection of substrate is performed by QA to ensure removal and cleaning of the substrate is adequate. The Contractor may accompany this inspection. If during the inspection, the substrate or plastic sheeting isn't cleaned to the satisfaction of the QA, additional re-cleaning will be required to meet the satisfaction of the QA.
- G. Encapsulate substrate and all remaining plastic sheeting within the work area. A colored encapsulant may be used on non-finished surfaces.
- H. After encapsulant has dried, remove floor, wall and ceiling plastic carefully by folding inwards into bundles and bag for disposal. NOTE: Final barriers are not to be removed until work is completed.
- I. With critical barriers in place, negative pressure system operating, and immovable objects covered with plastic sheeting, perform a second cleaning as was done in the first cleaning. Wet mop any hard floor surfaces. HEPA vacuum carpeted area surfaces. Hard surfaced flooring such as concrete, terrazzo, VAT and ceramic tile, shall be wet mopped, allowed to dry, and damp mopped a second time with clean mop heads. All mop heads and cleaning cloths are to be discarded in the same manner as asbestos waste.
- J. All surfaces are to be left visually clean.
- K. Perform visual inspection of work area QA and Contractor shall complete **Certification of Visual Inspection** form found at the end of this Section.
- L. The QA shall take pre-clearance samples as specified in Air Sample Schedule, Section 1.07 as soon as feasible but no longer than twenty-four (24) hours after completion of all cleaning work, or as may be specified by the Department. If pre-clearance criteria are met, proceed with air testing for final clearance by Transmission Electron Microscopy (TEM) AHERA analytical methodology.

- M. If pre-clearance criteria are not met, repeat final cleaning until additional tests indicate acceptable levels have been achieved before proceeding with final clearance testing by TEM. Costs associated with additional cleaning and testing shall be borne by the Contractor.
- N. After air testing clearance criteria has been met, critical barriers and negative air pressure system can be removed.

### 3.7 DISPOSAL OF ASBESTOS WASTE

- A. All RACM and miscellaneous ACM debris will be transported to the pre-designated disposal site in accordance with the guidelines of the U.S. Environmental Protection Agency, Title 40, Part 61, Subpart M, and all local agencies' regulations. Ensure all waste bags/leak-tight container have facilities name, address, and contact person as required by NESHAP. Drums are to be used to transport bagged ACM's as required by regulation(s).
- B. EPA NESHAP Category I & II non-friable ACM may disposed of as C&D waste as allowed by regulation. If non-friable materials become friable they must then be disposed of as regulated ACM waste in an approved landfill.
- C. Workers loading/unloading the asbestos materials and machinery operators will wear respirators and disposable work clothing when handling material at the project and disposal site. Asbestos warning signs shall be posted on vehicle as required by regulation.
- D. The bags may be dumped from the drums into the burial site. If drums are used to transport the ACM bags, the bags may be dumped from the drums into the burial site. The drums may be reused. However, if a bag is broken or damaged, the entire drum should be buried.
- E. The landfill area used for dumping shall be certified to receive and buy materials contaminated by asbestos.
- F. Obtain completed Waste Shipment Record (WSR) for all RACM. WSR must also indicate amount of waste in cubic yards. Submit signed WSR with Final Report/Project Close-out.

### 3.8 INSPECTIONS

- A. All work procedures detailed in this specification will be strictly adhered to and meet or exceed all current EPA, OSHA, DEP, ASTM and PDL&I regulations.
- B. All work shall meet with the approval of the Department. Work which does not meet with the approval shall be determined to be unsatisfactory.

**ASBESTOS CERTIFICATION OF VISUAL INSPECTION**

Project Name: State Museum of PA 1<sup>st</sup>, 2<sup>nd</sup> & 5<sup>th</sup> floors  
Project Number: D.G.S. 946-12 Phase 4  
Building Name: State Museum of PA  
Work Area Location: 1<sup>st</sup>, 2<sup>nd</sup> & 5<sup>th</sup> floors

**ABATEMENT CONTRACTOR CERTIFICATION**

In accordance with Project Specifications and scope of work, the abatement contractor hereby certifies that the Abatement Contractor has visually inspected the work area (all surfaces including pipes, beams, ledges, walls, ceiling and floor, decontamination unit, sheet plastic, etc.) and has found no asbestos dust, debris or residue.

Abatement Contractor Name: \_\_\_\_\_

Signature: \_\_\_\_\_ Print Name: \_\_\_\_\_

Print Title: \_\_\_\_\_ Date: \_\_\_\_\_

**QUALITY ASSURANCE CONSULTANT**

The Quality Assurance Consultant hereby certifies that he/she has accompanied the Abatement Contractor on the visual inspection and verifies that this inspection has been thorough and to the best of his/her knowledge and belief, the Abatement Contractor's certification above is a true and honest one.

Quality Assurance Consultant Name: BT Environmental Health & Safety Consultants

Inspector Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Print Inspector Name: \_\_\_\_\_

END OF SECTION 017100

## SECTION 019100

### COMMISSIONING REQUIREMENTS

#### PART 1 – GENERAL

##### 1.1 STIPULATIONS

- A. The Specifications Sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the Client Agency's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.
- B. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
  - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
  - 2. Verify and document proper performance of equipment and systems.
- C. The commissioning process does not take away from or reduce the responsibility of the installing contractors to provide a finished and fully functioning product.

##### 1.3 REFERENCES, RESOURCES

- A. ASHRAE Guideline 0-2005: The Commissioning Process, ASHRAE, 2005
- B. ASHRAE Guideline 1.1-2007: HVAC&R Technical Requirements for the Commissioning Process, ASHRAE, 2007
- C. ASHRAE Guideline 4-1993: Preparation of Operations & Maintenance Documentation for Building Systems, ASHRAE, 1993

##### 1.4 DEFINITIONS

- A. Use of terms and abbreviations referring to the Controls Subcontractor (CC) and the Testing and Balancing (TAB) Contractor shall be understood to mean the Subcontractors to the HVAC Contractor for these specific portions of the Work.

## 1.5 COORDINATION

- A. Commissioning Team. The members of the commissioning team consist of the Commissioning Authority (CxA), the DGS Representative (DGS), the Using Agency representative (UA), the General Contractor (0.1 Contractor), the Professional, the HVAC Contractor (0.2 Contractor), the Electrical Contractor (0.4 Contractor), the Test and Balance Contractor (TAB) representative, the Controls Subcontractor (CC), any other installing subcontractors or suppliers of equipment. The Using Agency's facilities staff is also a member of the commissioning team.
- B. Management. The CxA for this Project has been hired by the Department. The CxA directs and coordinates the commissioning activities and reports to the Department and the Professional.
- C. Scheduling. The CxA will provide the initial schedule of primary commissioning events using the information gathered from the commissioning scoping meeting. The Commissioning Plan provides a format for this schedule. The timeline is fine-tuned as construction progresses. In particular, 30 days prior to startup of the primary HVAC equipment, the CxA meets with the DGS, UA and Contractors and develops a detailed commissioning schedule. The CxA will approve the commissioning schedule.
  - 1. General Contractor shall coordinate requirements of Construction Scheduling with this work.

## 1.6 COMMISSIONING PROCESS

- A. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
  - 1. Commissioning during construction begins with an initial commissioning meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.
  - 2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
  - 3. Equipment documentation is submitted to the CxA, electronically through E-Builder, during normal submittals, including detailed start-up procedures.
  - 4. The Contractors develop the full start-up plan by combining the manufacturer's detailed start-up and checkout procedures from the O&M manual, the normally used field checkout sheets and Prefunctional checklists provide by the CxA and completed by the Contractor.
  - 5. The Contractors submit all completed startup plan documentation to the CxA for review and approval.
  - 6. The CxA develops and documents functional performance test procedures. The contractor and/or his controls sub-contractor will perform the functional tests per the procedures developed by and provided by the CxA.
  - 7. Items of non-compliance are resolved at commissioning meetings.
  - 8. Items of non-compliance in material, installation or setup are corrected at the Contractor's expense and the system retested.
  - 9. Contractor / manufacturer equipment start-ups, controls installation and programming, and the preliminary TAB report are completed four weeks prior to Substantial Completion. This includes submission of all associated documentation to the CxA, which is required to allow sufficient time for the CxA's Functional Testing. Contingent on these items and weather conditions, functional testing may be completed prior to occupancy.
  - 10. Deferred testing is conducted, as specified or required.

## 1.7 RESPONSIBILITIES

A. The responsibilities of various parties in the commissioning process are provided in this section. The responsibilities of the HVAC, TAB, and Controls Subcontractors are in Section 230800. The responsibilities of the Electrical Contractor are in Section 260800. It is noted that the services for the DGS Representative, Architect, mechanical and electrical designers/engineers, and Commissioning Authority are not provided for in this contract. That is, the Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process.

### B. All Parties

1. Attend the initial commissioning meeting conducted at the start of construction, the commissioning meeting held 30 days prior to startup of the primary equipment, and additional meetings, as necessary.

### C. Professional

#### *Construction and Acceptance Phase*

1. Perform normal submittal review, construction observation, record drawing preparation, and O&M manual approval in accordance with Division 1, etc., as contracted.
2. Provide any design narrative documentation requested by the CxA.
3. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
4. Prepare and submit final record basis of design documentation for inclusion in the Commissioning Reports.

#### *Warranty Period*

5. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning.

### D. Mechanical and Electrical Designers/Engineers (of the Professional)

#### *Construction and Acceptance Phase*

1. Perform normal submittal review, construction observation, record drawing preparation, and O&M manual approval in accordance with Division 1, etc., as contracted.
2. Provide any design narrative and sequences documentation requested by the CxA.
3. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.
4. Prepare and submit the final record basis of design and operating parameters documentation for inclusion in the O&M manuals.

#### *Warranty Period*

5. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.

### E. Commissioning Authority (CxA)

The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving, non-conformance or deficiencies, but ultimately that responsibility resides with the contractor and the Professional. The primary role of the CxA is to ensure that the Using Agency's project requirements are achieved through the construction and operation of the facility.

### *Construction and Acceptance Phase*

1. Installation Observation: the CxA shall observe installation of each type of commissioned feature and system to ensure that they are properly installed according to the contract documents and manufacturers' instructions and that other building systems or components are not compromising the performance of the feature.
2. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
3. Coordinate the commissioning work and, with the Lead Contractor and DGS, ensure that commissioning activities are being scheduled into the master schedule.
4. Plan and conduct a commissioning scoping meeting and other commissioning meetings.
5. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures.
6. Recommend approval of systems startup by reviewing start-up reports and by selected site observation.
7. Oversee sufficient construction and startup (construction checklist) of the control system and review the final point-to-point checkout completed by the Controls Contractor.
8. Develop and document functional performance test procedures.
9. Maintain a corrective action list and a separate testing record. Provide to the Department written progress reports and test results with recommended actions.
10. Review equipment warranties to ensure that the Department's responsibilities are clearly defined.
11. Provide a final commissioning report. The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report shall contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas:
  - a. Equipment meeting the Using Agency's project requirements
  - b. Equipment meeting the equipment specifications
  - c. Equipment ensuring proper installation
  - d. Functional performance and efficiency
  - e. Equipment documentation
  - f. All outstanding non-compliance items shall be specifically listed.
  - g. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

### *Warranty Period*

12. Coordinate and supervise required seasonal or deferred testing and deficiency corrections and provide the final testing documentation for the commissioning record and O&M manuals.

## F. DGS Representative (DGS)

### *Construction and Acceptance Phase*

1. The Department manages the CxA contract.
2. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the Commissioning Plan—Construction Phase.
3. Provide final approval for the completion of the commissioning work.

*Warranty Period*

4. Ensure that any seasonal or deferred testing and any deficiency issues are addressed.

## 1.8 SYSTEMS TO BE COMMISSIONED

- A. The systems that shall be commissioned in this project include but are not limited to the following:
  1. Ductless Heat Pump Units.
  2. Air Valve Boxes.
  3. Building Automation System (BAS).
  4. Electrical Power Distribution Systems.
  5. Lighting and Control Systems.
  6. Fire Alarm Systems.
  7. Security, Alarm and Detection Systems.
  8. Communication Systems.

## PART 2 – PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 MEETINGS

- A. Initial Commissioning Meeting. Within thirty (30) days of commencement of construction, the CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to prepare the *Commissioning Plan*, which will also be distributed to all parties.
- B. Equipment Startup Coordination Meeting. Thirty (30) days prior to startup of the primary HVAC equipment, the CxA meets with the DGS, UA, Professional and Contractors and develops a detailed commissioning schedule. Prior to this meeting, the Contractors shall submit to the CxA the full start-up plan.
- C. Miscellaneous Meetings. Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Contractors.

### 3.2 REPORTING

- A. The CxA will provide regular reports to the Department, with increasing frequency as construction and commissioning progresses.
- B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through progress reports.
- C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.



### 3.3 SUBMITTALS

- A. Copies of MEP shop drawings will be provided to CxA, when they are submitted to the Professional, electronically through E-Builder. CxA will review shop drawings concurrently with the Professional and provide any comments to the Professional so they may be included in their comments. Copies of approved shop drawings and startup reports for all commissioned equipment will be forwarded to the CxA through E-Builder. Supplement the shop drawing data with the manufacturer's installation and start-up procedures. This material should be identical to the literature which will be included in the Operation and Maintenance Manuals.
- B. The CxA may request additional design narrative from the Professional and Controls Contractor, depending on the completeness of the basis of design documentation and sequences provided with the Specifications.
- C. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the Professional will approve them.

### 3.4 START-UP AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned.
- B. General. Contractor start-ups are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full Contractor start-up. The start-up for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed.
  - 1. The Contractors develop the full start-up plan by combining the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
  - 2. The Contractors submit all completed startup plan documentation to the CxA for review and approval.
  - 3. For systems that may not have adequate manufacturer startup and checkout procedures, particularly for components being integrated with other equipment, the contractor should provide the added necessary detail and documenting format to the CxA for approval, prior to execution.
  - 4. The full start-up plan shall consist of:
    - a. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
    - b. The manufacturer's normally used field checkout sheets.
- D. Execution of Startup and Checkout Procedures.
  - 1. Thirty (30) days prior to startup, the contractors and vendors schedule startup and initial checkout with the DGS, UA, Professional and CxA. A commissioning meeting will be held at this time for all parties.

2. The Contractors and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and checkout procedures and completed Prefunctional Checklists.
3. Only individuals that have direct knowledge and witnessed that a line item task on the checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

E. Deficiencies, Non-Conformance and Approval in Checklists and Startup.

1. The Contractors shall clearly list any outstanding items of the initial start-up and checkout procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.
2. The CxA will review the report and submits either a non-compliance report or recommend approval to the DGS. The installing Contractors or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner and shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA will recommend approval of the start-up plan to the DGS.

### 3.5 FUNCTIONAL PERFORMANCE TESTING

- A. The Contractor shall execute all functional performance testing. The CxA will witness and document all performance testing.
- B. Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the documented Owner's Project Requirements (OPR), Basis of Design (BOD) and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.
- C. Coordination and Scheduling. The Contractors shall provide sufficient notice to the CxA regarding their completion schedule for the startup of all equipment and systems. The CxA shall provide written notice of testing dates. In general, functional testing is conducted after startup has been satisfactorily completed. The control system is sufficiently tested and approved before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting, individual systems has been achieved, the interface or coordinated responses between systems is checked.
- D. Problem Solving. The CxA will recommend solutions to problems found, however the burden of responsibility to solve and correct problems is with the Contractors and Professional.

### 3.6 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

- A. Documentation. The CxA will document the results of all functional performance tests using the specific procedural forms developed for that purpose. The CxA will include the filled out forms in the Commissioning Record.
- B. Non-Conformance.
  - 1. If the Contractor is available, corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution shall be documented on the procedure form.
  - 2. Every effort shall be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Department.
  - 3. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
    - a. When there is no dispute on the deficiency, the Contractor accepts responsibility to document and complete the corrective action.
    - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible, the deficiency shall be documented and submitted to the Professional and DGS for further review. Final interpretive authority is with the Professional. Final acceptance authority is with the DGS.

### 3.7 WARRANTY PERIOD TESTING

- A. During the warranty period, the CxA shall complete seasonal testing (tests delayed until weather conditions are closer to the system's design). The Professional shall coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning. Any final adjustments to the O&M manuals and record drawings due to the testing shall be made.

END OF SECTION 019100

## SECTION 024119

### SELECTIVE STRUCTURE DEMOLITION

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Demolition and removal of selected portions of building or structure.

- B. Related Requirements:

- 1. Sections 017100 "Removal of Asbestos-Containing Materials" and 107200 "Removal/Disposal of PCB and Mercury-Containing Materials" for abatement of hazardous materials.

##### 1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Department ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

##### 1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including other items of interest or value to the Client Agency that may be uncovered during demolition remain the property of the Client Agency.
  - 1. Client Agency shall be promptly consulted to determine the legitimacy of any uncovered or discovered items in question.
  - 2. Carefully salvage in a manner to prevent damage and promptly return to Client Agency.

## 1.5 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at Project site.
  - 1. Inspect and discuss condition of construction to be selectively demolished.
  - 2. Review structural load limitations of existing structure.
  - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  - 5. Review areas where existing construction is to remain and requires protection.

## 1.6 SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property for dust control and for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Client Agency's on-site operations are uninterrupted.
  - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
  - 4. Use of elevator and stairs.
  - 5. Coordination of Client Agency's continuing occupancy of portions of existing building and of Client Agency's partial occupancy of completed Work.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Client Agency prior to start of demolition.
  - 1. In addition to submitting the above via eBuilder, submit paper copy to the Client Agency.
- E. Pre-demolition Photographs or Video: Submit before Work begins.
  - 1. In addition to submitting the above via eBuilder, submit digital files to the Client Agency.
- F. Inventory: Submit a list of items that have been removed and salvaged.
- G. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

## 1.7 FIELD CONDITIONS

- A. Client Agency will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Client Agency's operations will not be disrupted.
- B. Conditions existing at the time of inspection for bidding purpose will be maintained by Client Agency as far as practical.

1. Before selective demolition, Client Agency will remove the following items:
  - a. Loose furniture and equipment.
- C. Notify Professional of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
  1. Hazardous material remediation is specified elsewhere in the Contract Documents.
  2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
  3. Department will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
- E. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  1. Maintain fire-protection facilities in service during selective demolition operations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Department or Client Agency. The Department does not guarantee that existing conditions are same as those indicated in record documents.

- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Professional.
- E. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, preconstruction videotapes and templates.
  - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
  - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
  - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Client Agency will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Department.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  - 2. Provide temporary dust tight partitions around areas of demolition work.
  - 3. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  - 4. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  - 5. Cover and protect furniture, furnishings, and equipment that have not been removed.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
  - 1. Strengthen or add new supports when required during progress of selective demolition.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
  - 5. Maintain adequate ventilation when using cutting torches.
  - 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  - 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.



8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  9. Dispose of demolished items and materials promptly.
- B. Work in Historic Areas: Selective demolition may be performed only in areas of the Project that are not designated as historic. In historic spaces, areas, and rooms or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling." Consult with the Client Agency for guidance when working in these areas. Historic areas include the following:
1. Ground Floor, west of Column Line A01/P01.
  2. Ground Floor:
    - a. Auditorium Foyer G98.
    - b. Auditorium G120.
    - c. Stage G121.
  3. First Floor:
    - a. Memorial Hall 114.
    - b. All exhibit areas.
  4. Second Floor:
    - a. Balcony 220.
    - b. All exhibit areas.
  5. Third Floor:
    - a. Balcony 311.
    - b. All exhibit areas.
- C. Removed and Salvaged Items (Consult with Client Agency prior to proceeding):
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until receipt by Client Agency.
  4. Transport items to Client Agency's storage area off-site (within 10 minutes one-way of the site).
  5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items (Consult with Client Agency prior to proceeding):
1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain (Consult with Client Agency prior to proceeding): Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Professional, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

### 3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Department's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Department's property and legally dispose of them.

### 3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

## SECTION 033053

### MISCELLANEOUS CAST-IN-PLACE CONCRETE

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Action Submittal:
  - 1. Design Mixtures: For each concrete mixture.

##### 1.4 QUALITY CONTROL

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. Comply with the following sections of ACI 301 (ACI 301M), unless modified by requirements in the Contract Documents:
  - 1. "General Requirements."
  - 2. "Formwork and Formwork Accessories."
  - 3. "Reinforcement and Reinforcement Supports."
  - 4. "Concrete Mixtures."
  - 5. "Handling, Placing, and Constructing."
- C. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

#### PART 2 - PRODUCTS

##### 2.1 FORMWORK

- A. Furnish formwork and formwork accessories according to ACI 301 (ACI 301M).

## 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
- D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

## 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project:
  - 1. Portland Cement: ASTM C 150, Type I. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class C or F.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregate: ASTM C 33, graded, 1-1/2-inch (38-mm) nominal maximum aggregate size.
- C. Water: ASTM C 94/C 94M.

## 2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.5 RELATED MATERIALS

- A. Vapor Retarder: Plastic sheet, ASTM E 1745, Class A or B.
- B. Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick; or plastic sheet, ASTM E 1745, Class C.
- C. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

## 2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

## 2.7 CONCRETE MIXTURES

- A. Comply with ACI 301 (ACI 301M) requirements for concrete mixtures.
- B. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301 (ACI 301M), as follows:
  - 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
  - 3. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
  - 4. Slump Limit: 4 inches (100 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
  - 5. Air Content: Maintain within range permitted by ACI 301 (ACI 301M). Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

## 2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116, and furnish batch ticket information.
  - 1. When air temperature is above 90 deg. F (32 deg. C), reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, construct, erect, brace, and maintain formwork according to ACI 301 (ACI 301M).

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

### 3.3 VAPOR RETARDERS

- A. Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.
  - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended adhesive or joint tape.

### 3.4 STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

### 3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Locate and install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Professional.

### 3.6 CONCRETE PLACEMENT

- A. Comply with ACI 301 (ACI 301M) for placing concrete.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).
- C. Do not add water to concrete during delivery, at Project site, or during placement.
- D. Consolidate concrete with mechanical vibrating equipment.

### 3.7 FINISHING FORMED SURFACES

- A. Rubbed Finish: Apply the following rubbed finish, defined in ACI 301 (ACI 301M), to smooth-formed finished as-cast concrete where indicated:
  - 1. Grout-cleaned finish.

- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.8 FINISHING UNFORMED SURFACES

- A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.
  - 1. Do not further disturb surfaces before starting finishing operations.
- C. Scratch Finish: Apply scratch finish to surfaces indicated and surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes, unless otherwise indicated.
- D. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, fluid-applied or direct-to-deck-applied membrane roofing, or sand-bed terrazzo.
- E. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.

### 3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 (ACI 301M) for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests: Perform according to ACI 301 (ACI 301M).
  1. Testing Frequency: One composite sample shall be obtained for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m) but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
  2. Testing Frequency: One composite sample shall be obtained for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mix placed each day.

### 3.11 REPAIRS

- A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION 033053



## SECTION 040140

### MAINTENANCE OF STONE ASSEMBLIES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes maintenance of stone masonry consisting of repairs to stone failures of the Alabama Limestone and the State Museum and Archives of the following types:
  - 1. Dutchman repairs, including removal of existing Dutchman.
  - 2. Spall repairs.
  - 3. Mortar patch repairs.
  - 4. Combination spall/mortar patch repairs.
  - 5. Crack repairs.
  - 6. Cleaning of stone to remove dust, dirt and debris resulting from repair work.
  - 7. Painting of exposed steel.
- B. The drawings identify the location of each required repair and an "X" and "Y" coordinate system. Refer to the chart at the end of this Section for the type (detail) of repair required at each location.
- C. Related Sections:
  - 1. Section 016200 "Historical and Museum Supplemental Provisions" for list of Client Agency prequalified masonry restoration contractors. The work of this section must be performed by a pre-qualified contractor listed in Section 016200.
  - 2. Section 010250 "Unit Prices" for additions and/or reductions in the quantity of repairs.
  - 3. Section 040141 "Cleaning of Stone Assemblies" for cleaning stone surfaces after repair work is complete.

##### 1.3 DEFINITIONS

- A. Very Low-Pressure Spray: Under 100 psi (690 kPa).
- B. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).
- C. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).
- D. High-Pressure Spray: 800 to 1200 psi (5510 to 8250 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).
- E. Stone Terminology: ASTM C 119.

- F. Face Bedding: Setting of stone with the natural bedding planes (strata) vertical and parallel to the wall plane rather than horizontal or "naturally bedded," which holds bedding planes together by gravity.

#### 1.4 QUALITY CONTROL

- A. Restoration Specialist Qualifications: Engage an experienced masonry restoration firm to perform work of this Section. Firm shall be pre-qualified by the Pennsylvania Historic and Museum Commission (PHMC).
- B. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-trained representatives who are available for consultation and Project-site inspection and assistance at no additional cost.
- C. Mockups: Prepare mockups of each type of stone repair to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Professional specifically approves such deviations in writing.
  - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Cleaning: Clean an area approximately 25 sq. ft. (2.3 sq. m) for each type of stone and surface condition.
  - 1. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not use cleaners and methods known to have deleterious effect.
  - 2. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.
- E. Pre-installation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to stone masonry restoration and cleaning including, but not limited to, the following:
    - a. Construction schedule. Verify availability of materials, Restoration Specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
    - b. Materials, material application, sequencing, tolerances, and required clearances.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver stone to Project site strapped together in suitable packs or pallets or in heavy-duty cartons.
- B. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

## 1.6 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit stone restoration and cleaning work to be performed according to manufacturers' written instructions and specified requirements.
- B. Perform stone repairs only when air temperature is between 40 and 90 deg. F (4 and 32 deg. C) and is predicted to remain so for at least 7 days after completion of the Work unless otherwise indicated.
- C. Cold-Weather Requirements: Comply with the following procedures for stone repairs:
  - 1. When air temperature is below 40 deg. F (4 deg. C), heat stone repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg. F (4 and 49 deg. C).
- D. Hot-Weather Requirements: Protect masonry repair and mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg. F (32 deg. C) and above unless otherwise indicated.
- E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

## 1.7 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.
- B. Samples for Verification: For the following:
  - 1. Each type of replacement stone required for Dutchman. Include sets of Samples as necessary to show full range of color, texture, grain, veining, and finish to be expected. Provide sets of at least two 12-by-12-inch (300-by-300-mm) Samples for each type, but no fewer than necessary to indicate full range and the proportion of variations within range.
  - 2. Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches (150 mm) long by 1/4 inch (6 mm) wide, set in aluminum or plastic channels.
    - a. Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.
  - 3. Each type of stone patching compound in form of briquettes, at least 3 inches (75 mm) long by 1-1/2 inches (38 mm) wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.
  - 4. Each type of adhesive.
  - 5. Sealant Materials: See Section 079200 "Joint Sealants."
  - 6. Accessories: Each type of anchor, accessory, and miscellaneous support.
- C. Quality-Control Program.
- D. Restoration Program.
- E. Cleaning Program.

## 1.8 COORDINATION

- A. Coordinate stone repairs with public circulation patterns at Project site. Some work is near public circulation patterns and building entries. Public circulation patterns cannot be closed off entirely, and in places can be only temporarily redirected around small areas of work. Plan and execute the Work accordingly.

## 1.9 SEQUENCING AND SCHEDULING

- A. Order replacement materials at earliest possible date to avoid delaying completion of the Work.
- B. Perform stone repair work in the following sequence:
  1. Remove existing Dutchman and spalls where spalls cannot be salvaged for reuse.
  2. Clean any exposed steel at shelf angle supports and touch-up with cold galvanization repair paints.
  3. Remove sealant and mortar from joints for distance as indicated at type of repair
  4. Repair stone per details as indicated.
  5. Point mortar vertical joints and rake out mortar to depth of 1/2 joint width.
  6. Point joints with sealant.
  7. Touch-up Dutchman repairs with color stain kit to match grain of existing stone.
  8. Perform cleaning of designated areas.

## 1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit stone restoration and cleaning work to be performed according to manufacturers' written instructions and specified requirements.
- B. Repair stone units and repoint mortar joints only when air temperature is between 40 and 90 deg. F (4 and 32 deg. C) and is predicted to remain so for at least 7 days after completion of the Work unless otherwise indicated.
- C. Cold-Weather Requirements: Comply with the following procedures for stone repair and mortar-joint pointing unless otherwise indicated:
  1. When air temperature is below 40 deg. F, heat mortar ingredients, repair materials, and existing stone to produce temperatures between 40 and 120 deg. F (4 and 49 deg. C).
  2. When mean daily air temperature is below 40 deg. F (4 deg. C), provide enclosure and heat to maintain temperatures above 32 deg. F (0 deg. C) within the enclosure for 7 days after repair and pointing.
- D. Hot-Weather Requirements: Protect stone repair and mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar and patching materials. Provide artificial shade and wind breaks and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg. F (32 deg. C) and above unless otherwise indicated.
- E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.
- F. Clean stone surfaces only when air temperature is 40 deg. F (4 deg. C) and above and is predicted to remain so for at least 7 days after completion of cleaning.

## PART 2 - PRODUCTS

### 2.1 STONE MATERIALS

- A. Stone: For Dutchman, provide natural building stone of variety, color, texture, grain, veining, finish, size, and shape to match existing stone and with physical properties as listed below:
  - 1. Physical Properties:
    - a. Compressive Strength: 4.220 psi per ASTM C 170.
    - b. Modulus of Rupture: 790 psi per ASTM C 99.
    - c. Absorption: 4.7 percent per ASTM C 97.
    - d. Bulk Specific Gravity: 2.314 per ASTM C 97.
  - 2. Subject to compliance with requirements, provide stone from the original quarry, which is Alabama Limestone, Russellville, Alabama.
    - a. Vetter Stone, 23894 Third Avenue, Mankato, MN 56001 (800) 878-2850 vetterstone.com.

### 2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II, white, or gray or both where required for color matching of exposed mortar.
  - 1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Factory-Prepared Lime Putty: ASTM C 1489.
- D. Mortar Sand: ASTM C 144 unless otherwise indicated.
  - 1. Color: Provide natural sand.
- E. Water: Potable.

### 2.3 MANUFACTURED REPAIR MATERIALS

- A. Stone Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching stone.
  - 1. Product: Subject to compliance with requirements, provide one of the following:
    - a. Cathedral Stone Products, Inc.; Jahn Restoration Mortars.
    - b. Conproco Corporation; Mimic.
    - c. Edison Coatings, Inc.; Custom System 45.
    - d. Bonstone Materials Corp.; Last Patch Gel.

2. Use formulation that is vapor- and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than the stone units being repaired, and develops high bond strength to all types of stone.
  3. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
  4. Formulate patching compound in colors, textures, and grain to match stone being patched. Provide not less than three colors to enable matching each piece of stone.
- B. Stone-to-Stone Adhesive: 2-part polyester or epoxy-resin stone adhesive with a 15- to 45-minute cure at 70 deg. F (21 deg. C) or 1-part cementitious stone adhesive, recommended by adhesive manufacturer for type of stone repair indicated, and matching stone color.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Two-Part Polyester or Epoxy-Resin Stone Adhesive:
      - 1) Akemi North America; MS76 Stone and Marble Adhesive.
      - 2) Bonstone Materials Corporation; Fast Set 41.
      - 3) Edison Coatings, Inc.; Flexi-Weld 520T.
    - b. One-Part Cementitious Stone Adhesive:
      - 1) Cathedral Stone Products, Inc.; Jahn Restoration Adhesive.

## 2.4 ACCESSORY MATERIALS

- A. Stone Pins: Size indicated. Fabricate pins from Type 304 stainless steel.
- B. Single-Component, Non-sag, Neutral-Curing, Low-Modulus, Non-Staining Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Spectrum 3; Tremco, Incorporated, or equivalent product from one of the following:
    - a. Dow Corning Corporation.
    - b. GE Advanced Materials.
    - c. Pecora Corporation.
  2. Colors: Provide colors of exposed sealants to match colors of stonework adjoining installed sealant unless otherwise indicated.
- C. Joint-Sealant Backing:
1. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or Type B (bi-cellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
  2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.
- D. Weep/Vent Products: Use the following unless otherwise indicated:

1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, 3/8-inch-thick, 1/8 inch less than depth of the stone panel; in color selected from manufacturer's standard.
  - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mortar Trap™ in color Almond; Hohmann & Barnard, Inc., or an equivalent product by one of the following:
    - 1) Heckman Building Products, Inc.
    - 2) Mortar Net USA, Ltd.

E. Masking Tape: Non-staining, nonabsorbent material, compatible with pointing mortar, joint primers, sealants, and surfaces adjacent to joints; that will easily come off entirely, including adhesive.

F. Antirust Coating: Fast-curing, lead- and chromate-free, zinc-rich, self-curing, universal modified-alkyd primer.

1. Subject to compliance with requirements, provide Cold Galvanizing Paint; Rust-oleum®, or an equivalent product from one of the following:
  - a. Pittsburgh Paints.
  - b. Sherwin Williams.

G. Miscellaneous Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Little possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:
  - a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
  - b. Leave a residue on surfaces.

H. Masonry Stain: Sol silicate base thin layer translucent coating for concrete.

1. Basis-of-Design Product: Subject to compliance with requirements, provide KEIM Concretal Lasur; KEIM Mineral Coatings, or equivalent product by one of the following as approved by the Professional:
  - a. Euclid Chemical.
  - b. Valspar
2. Color: As selected by the Professional from manufacturer's full color range and blended as required to match color of existing Alabama Limestone.

## 2.5 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg. F (60 to 71 deg. C).

- C. Job-Mixed Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

## 2.6 PAINT MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. PPG Architectural Finishes, Inc.
  - 2. Sherwin-Williams Company (The).
  - 3. Tnemec.
- B. Products: Subject to compliance with requirements, provide products listed in other Part 2 articles for the paint category indicated or equivalent products from one of the other manufacturers listed.
- C. Colors: As selected by Professional and Client Agency.
- D. Acrylic Primer MP-1:
  - 1. Basis-of-Design Product: Pro-Cryl Universal Primer; Sherwin Williams.
- E. Polyurethane, Two-Component, Pigmented, Gloss: PC-1.
  - 1. Basis-of-Design Product: Acrolon 218 B65-600; Sherwin Williams.

## 2.7 MORTAR MIXES

- A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
  - 1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not re-temper or use partially hardened material.
- B. Do not use admixtures in mortar unless otherwise indicated.
- C. Mortar Proportions: Mix mortar materials in the following proportions:
  - 1. Pointing Mortar for Stone: 1-part white portland cement, 1-part lime, and 6 parts sand.

## 2.8 CHEMICAL CLEANING SOLUTIONS

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended by chemical-cleaner manufacturer.



- B. Acidic Cleaner Solution for Unpolished Stone: Dilute with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended by chemical-cleaner manufacturer.

## PART 3 - EXECUTION

### 3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from stone restoration work.
  - 1. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of restoration and cleaning work.
- B. Prevent mortar from staining face of surrounding stone and other surfaces.
  - 1. Cover sills, ledges, and projections to protect from mortar droppings.
  - 2. Keep wall area wet below pointing work to discourage mortar from adhering.
  - 3. Immediately remove mortar in contact with exposed stone and other surfaces.
  - 4. Clean mortar splatters from scaffolding at the end of each day.
- C. Comply with chemical-cleaner manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
  - 1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used unless chemical cleaners being used will not damage adjacent surfaces. Use materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
  - 2. Keep wall wet below area being cleaned to prevent streaking from runoff.
  - 3. Do not clean stone during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
  - 4. Neutralize and collect alkaline and acid wastes for disposal off Department's property.
  - 5. Dispose of runoff from cleaning operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

### 3.2 DUTCHMAN REPAIR (DMR DETAIL 01/A4.11)

- A. Remove existing Dutchman, anchor pins and other extraneous items.
  - 1. Remove items carefully to avoid spalling or cracking adjacent stone.
  - 2. Cut new Dutchman from Alabama Limestone, matching vein pattern and color of adjacent stone as closely as possible.
  - 3. Mask adjacent areas of stone to above staining with epoxy over bleed.
  - 4. Set Dutchman into place with epoxy adhesive and stainless pins as detailed. Temporarily wedge, shim and brace Dutchman until epoxy has set.

5. After epoxy has set, grind out epoxy from joints to a depth of 1/8 to 1/4-inch. Point joints with repair mortar.
6. Point holes for recessed stainless-steel pins with repair mortar.
7. Use color kit to create faux vein pattern to match adjacent stone.

### 3.3 SPALL REPAIR (SP Detail 02/A4.11)

- A. Carefully remove cracked stone spall fragment indicated to be repaired. Reuse only stone fragment that is in sound condition.
- B. Remove soil, loose particles, mortar, and other debris or foreign material, from spall surfaces to be bonded and from parent stone where fragment had broken off, by cleaning with stiff-fiber brush.
- C. Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, threaded stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled at a 45-degree downward angle through face of fragment and into parent stone. Center and space pins between 3 and 5 inches (75 and 125 mm) apart and at least 2 inches (50 mm) from any edge. Insert pins at least 2 inches (50 mm) into parent stone and 1 inch into fragment with end countersunk at least 1/4 inch (6 mm) from exposed face of fragment.
- D. Mask adjacent areas of stone to above staining with epoxy over bleed.
- E. Apply stone-to-stone adhesive to comply with adhesive manufacturer's written instructions. Coat bonding surfaces of fragment and parent stone, completely filling all crevices and voids.
- F. Fit stone fragment onto parent stone while adhesive is still tacky and hold fragment securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of fragment with face of parent stone.
- G. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes as specified in "Mortar Repair" Article.

### 3.4 MORTAR REPAIR (MR DETAIL 03/A4.11 and 06/A4.11)

- A. Patch the following stone units unless another type of replacement or repair is indicated:
  1. Units indicated to be patched.
- B. Remove existing patches, sealant and other failed repair materials.
- C. Remove deteriorated material and remove adjacent material that has begun to deteriorate. Carefully remove additional material so patch will not have feathered edges but will have square or slightly undercut edges on area to be patched and will be at least 1-inch-thick, but not less than recommended by patching compound manufacturer.
- D. Mask adjacent mortar joint or rake out for repointing if patch will extend to edge of stone unit.
- E. Mix patching compound in individual batches to match each stone unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
- F. Brush-coat stone surfaces with slurry coat of patching compound according to manufacturer's written instructions.

- G. Place patching compound in layers as recommended by patching compound manufacturer, but not less than 1/4 inch or more than 1-1/2-inches thick. Roughen surface of each layer to provide a key for next layer.
  - 1. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the stone. Shape and finish surface before or after curing, as determined by testing, to best match existing stone.
  - 2. Build patch up 1/4 inch (6 mm) above surrounding stone and carve surface to match adjoining stone after patching compound has hardened.
- H. Keep each layer damp for 72 hours or until patching compound has set.
- I. Remove and replace patches with hairline cracks or that show separation from stone at edges, and those that do not match adjoining stone in color or texture.

### 3.5 CRACK REPAIR (CR Detail 05/A4.11)

- A. General: Comply with epoxy manufacturer's written instructions.
- B. Drill 1/4-inch- (6-mm-) diameter injection holes as follows:
  - 1. Drill holes through center of crack at 4 to 6 inches o.c.
  - 2. Drill holes 2 inches (50 mm) deep.
- C. Clean out drill holes and cracks with compressed air. Remove dirt and organic matter, loose material, sealants, and failed crack repair materials.
- D. Mask adjacent areas of stone to above staining with epoxy over bleed.
- E. Place plastic injection ports in drilled holes and seal face of cracks between injection ports with clay or other non-staining, removable plugging material. Leave openings at upper ends of cracks for air release.
- F. Inject epoxy adhesive through ports sequentially, beginning at one end of area and working to opposite end; where possible, begin at lower end of injection area and work upward. Inject filler until it extrudes from adjacent ports. After port has been injected, plug with clay or other suitable material and begin injecting filler at adjacent port, repeating process until all ports have been injected.
- G. Clean epoxy adhesive from face of stone before it sets.
- H. After epoxy has set, remove injection ports, plugging material, and excess filler. Grind back epoxy from face of stone 1/8- to 1/4-inch depth. Patch injection holes and surface of cracks as specified in "Mortar Repair" Article.

### 3.6 PAINTING STEEL UNCOVERED DURING THE WORK

- A. It is anticipated that the toe of the steel shelf angles will be exposed at the majority of the stone repairs. Inspect steel exposed during stone removal. Prepare and paint exposed portions as follows:
  - 1. Remove paint, rust, and other contaminants according to SSPC-SP 3, "Power Tool Cleaning", as applicable to meet paint manufacturer's recommended preparation.

2. Immediately paint exposed steel with primer and one coat of paint material specified in this Section, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).

### 3.7 REPOINTING STONework

- A. Rake out and repoint joints to the following extent:
  1. All joints.
    - a. All bed joints at shelf angles shall have all mortar completely removed. Joints shall be fitted with a backer rod caulked with sealant.
    - b. All other joints shall be repointed with sealant over existing mortar.
- B. Do not rake out and repoint joints where not required.
- C. Joints other than bed joints at shelf angles: Rake out joints as follows, according to procedures demonstrated in approved mockup:
  1. Remove all sealant.
  2. Remove mortar from joints to depth of 1/2 times joint width.
  3. Remove mortar from stone surfaces within raked-out joints to provide reveals with square backs and to expose stone for contact with pointing mortar. Brush, vacuum, or flush joints with air to remove dirt and loose debris.
  4. Do not spall edges of stone units or widen joints.
    - a. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Strictly adhere to approved quality-control program.
  5. Tuck point all voids in existing joints, striking mortar recessed to a depth 1/2 the joint width.
- D. Notify Professional of unforeseen detrimental conditions including voids in mortar joints, cracks, loose stone, rusted metal, and other deteriorated items.
- E. Bed Joints with Shelf Angles: Remove all existing sealant and mortar to exposed tee or shelf angle.
  1. Inspect toe of shelf angle. Clean all rust with power tools with wire brush attachment.
  2. Brush, vacuum or flush joints with air to remove all dirt and loose debris.
- F. Pointing with Sealant Other than Bed Joints with Shelf Angles:
  1. Prepare joints as described above.
  2. Keep joints dry and free of loose mortar and debris.
  3. Clean and prepare joint surfaces according to sealant manufacturer's requirements. Prime joint surfaces unless sealant manufacturer recommends against priming.
  4. Fill sealant joints with specified joint sealant according to the following:
    - a. Install sealant using only proven installation techniques that will ensure that sealant will be deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding stonework and matching the contour of adjoining mortar joints.

- b. Do not allow sealant to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces, particularly rough textures. Remove excess and spillage of sealant promptly as the work progresses. Clean adjoining surfaces by the means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.

5. Cure sealant according to sealant manufacturer's requirements.

G. Sealant Bed Joints:

1. Install backer rod in open bed joints, set to provide joint depth that is 1/2 joint width or as recommended by the sealant manufacturer. If depth is less than 1/2 joint width, install bond breaker tape.
2. Install sealant over back rod and trowel flush with adjacent stone surfaces.

### 3.8 FINAL CLEANING

- A. Cleaning is limited to removing dust, excess mortar, etc., which is the result of repair work. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.
1. Do not use metal scrapers or brushes.
  2. Do not use acidic or alkaline cleaners.
- B. Wash adjacent woodwork and other non-stone surfaces. Use detergent and soft brushes or cloths.
- C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- D. Sweep and rake adjacent pavement and grounds to remove mortar and debris. Where necessary, pressure wash pavement surfaces to remove mortar, dust, dirt, and stains.

### 3.9 STAINING

- A. After cleaning of limestone per Specification Section 040141 "Cleaning of Stone Assemblies," apply masonry stain to all existing and new Dutchman repairs as required to blend in the color of the repairs with the field of stone.

### 3.10 FIELD QUALITY CONTROL

- A. Professional's Project Representatives: Professional will assign Project representatives to help carry out Professional's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Professional's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

END OF SECTION 040140

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
<b>NORTH ELEVATION</b>				
Dutchman Failed	2	117	16	DMR
Missing	2	198	50	SP
Patch Sound	3	23	2	MP
Patch Failed	3	28	2	MP
Patch Failed	3	39	20	SP
Present	3	39	20	SP/MP
Dutchman Failed	3	146	10	DMR
Patch Failed	4	19	9	SP
Repair Failed	4	125	0.5	CR
Missing	4	198	50	MP
Stone Crack	5	164	0.5	CR
Single Unit	6	39	4	SP
Patch Failed	7	185	25	SP
Patch Sound	10	107	3	MP
Patch Failed	11	5	30	MP
Patch Failed	11	40	1	SP
Patch Failed	11	127	20	SP
Patch Failed	12	155	36	MP
Missing	12	198	60	SP
Crack Repair	13	20	12	CR
Patch Sound	13	69	4	MP
Patch Failed	14	156	20	SP
Repair Failed	14	184	0.5	CR
Missing	14	198	40	SP
Patch Sound	15	78	1	MP
Present	16	98	5	SP
Present	16	165	12	SP
Present	18	165	12	SP
Patch Failed	18	175	48	MP
Patch Failed	19	165	12	SP
Spall Present	20	29	8	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Present	21	29	6	MP
Crack	21	153	8	CR
Patch Failed	22	60	10	MP
Crack	22	65	8	MP
Patch Failed	22	87	6	MP
Patch Failed	22	88	8	MP
Patch Failed	22	117	12	MP
Patch Failed	22	174	6	MP
Crack	22	181	16	MP
Patch Failed	23	65	24	MP
Patch Failed	23	145	8	MP
Patch Failed	24	68	16	MP
Present	24	76	12	MP
Patch Failed	24	81	12	MP
Crack	24	87	18	MP
Patch Failed	24	93	4	MP
Patch Failed	24	104	8	MP
Patch Failed	25	98	6	MP
Patch Failed	25	135	4	MP
Patch Failed	25	137	6	MP
Patch Failed	25	146	8	MP
Crack	25	162	18	CR
Patch Failed	25	174	4	MP
Crack	25	181	30	MP
Patch Failed	26	101	2	MP
Patch Failed	26	137	4	MP
Patch Failed	26	172	6	MP
Patch Failed	26	175	6	MP
Patch Failed	27	50	14	MP
Patch Failed	27	58	18	MP
Patch Failed	27	134	30	MP
Patch Failed	28	4	6	MP
Patch Sound	28	127	6	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
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 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Sound	28	136	6	MP
Present	28	165	4	SP
Patch Failed	28	175	30	MP
Spall Present	28	178	8	MP
Present	29	59	3	MP
Patch Failed	29	165	25	SP
Patch Sound	29	175	42	MP
Stone Crack	30	199	24	CR
Patch Failed	32	20	2	MP
Patch Failed	32	39	25	SP
Patch Failed	32	136	4	MP
Crack	33	178	6	CR
Missing	33	184	2	SP
Patch Failed	33	199	14	SP
Patch Failed	34	8	2	SP
Present	34	155	3	SP
Crack	34	185	24	CR
Patch Failed	35	107	24	MP
Present	35	136	14	SP
Patch Failed	35	146	3	SP
Patch Failed	36	4	48	MP
Present	36	184	2	SP
Patch Failed	37	197	40	SP
Patch Failed	38	30	6	SP
Patch Failed	38	145	65	SP
Crack	38	182	24	CR
Present	40	29	8	MP
Present	40	68	8	SP
Patch Failed	40	145	3	SP
Patch Sound	41	30	2	MP
Patch Failed	41	68	12	N
Patch Failed	41	97	3	MP
Present	41	175	2	MP



DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Missing	41	184	12	MP
Patch Sound	42	136	32	MP
Present	42	155	20	SP
Stone Crack	43	27	12	CR
Mortar Caulk Failed	44	88	6	CR
Patch Failed	44	155	25	SP
Patch Failed	45	40	10	MP
Present	45	68	3	SP
Present	45	89	27	SP
Missing	45	98	15	MP
Patch Failed	45	135	6	MP
Patch Failed	45	198	12	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
<b>WEST ELEVATION</b>				
Present	73	7	16	MP
Present	73	39	10	MP
Patch Sound	73	86	16	MP
Patch Sound	73	116	12	MP
Crack	73	146	12	CR
Missing	74	174	120	SP
Patch Failed	76	86	18	MP
Missing	76	146	18	SP
Missing	76	154	4	MP
Dutchman Sound	76	198	28	DMR
Present	77	7	2	MP
Patch Failed	77	29	1	MP
Missing	77	106	2	SP
Missing	77	107	4	SP
Crack Repair	77	198	16	CR
Missing	78	117	40	SP
Missing	81	39	2	MP
Patch Failed	81	126	1	MP
Stone Crack	81	184	24	CR
Patch Failed	82	97	24	SP
Stone Crack	82	106	24	CR
Present	82	136	12	SP
Patch Sound	82	164	12	MP
Patch Failed	83	165	14	MP
Patch Failed	83	184	8	MP
Ferrous Element	84	74	24	SP/MP
Patch Failed	84	117	3	MP
Missing	84	174	12	MP
Patch Failed	85	117	7	MP
Patch Failed	85	136	1	MP
Crack Repair	86	144	14	CR

DGS PROJECT C-0946-0012 PHASE 004  
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 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Failed	87	48	12	MP
Patch Failed	87	175	3	MP
Patch Sound	87	184	12	MP
Missing	87	197	12	MP
Patch Failed	88	50	8	MP
Present	88	154	6	MP
Patch Failed	89	174	6	MP
Present	90	106	6	MP
Missing	90	184	8	N
Patch Failed	91	106	8	MP
Patch Failed	92	96	1	MP
Patch Sound	93	87	2	DMR
Ferrous Element	93	122	12	SP/MP
Removed	94	58	1	MP
Present	94	116	9	MP
Patch Failed	94	154	1	MP
Missing	94	184	18	SP
Missing	96	38	1	MP
Dutchman Sound	96	87	24	DMR
Missing	96	184	12	MP
Patch Failed	99	87	16	SP
Patch Failed	99	127	6	MP
Missing	99	146	8	MP
Missing	100	49	8	MP
Patch Failed	100	58	4	MP
Present	100	165	8	MP
Missing	100	173	2	MP
Stone Crack	100	181	12	CR
Spall Present	101	51	10	MP
Dutchman Sound	101	86	40	DMR
Present	101	88	12	MP
Dutchman Failed	101	88	32	DMR
Present	101	107	4	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Dutchman Failed	101	126	80	DMR
Patch Sound	102	12	12	DMR
Dutchman Sound	102	68	20	MP
Dutchman Failed	102	68	40	DMR
Ferrous Element	102	72	26	MP
Ferrous Element	102	84	12	MP
Dutchman Failed	102	106	6	MP
Patch Sound	103	87	1	MP
Spall Present	103	87	4	MP
Patch Failed	103	116	1	MP
Present	103	155	8	MP
Spall Present	104	82	4	MP
Missing	105	88	24	MP
Spall Present	105	88	32	SP
Patch Failed	105	107	1	MP
Missing	105	126	3	MP
Present	105	155	20	MP
Patch Failed	106	197	6	MP
Present	108	117	5	MP
Present	108	126	25	SP
Present	109	39	15	SP
Missing	109	107	18	SP
Patch Failed	109	146	8	MP
Patch Failed	109	164	6	MP
Present	110	78	4	MP
Missing	111	78	15	MP
Missing	111	126	20	SP
Present	113	127	10	SP
Patch Sound	113	136	10	MP
Missing	113	165	24	SP
Patch Failed	114	29	8	MP
Patch Failed	114	107	3	MP
Present	118	136	12	SP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Missing	118	198	40	DMR
Missing	119	197	40	DMR
Missing	120	97	20	SP
Ferrous Element	122	83	18	MP
Patch Sound	122	84	24	MP
Crack	122	126	8	CR
Ferrous Element	122	179	4	SP/MP
Patch Failed	124	145	3	MP
Missing + Steel	125	48	50	SP
Patch Failed	125	116	4	MP
Stone Crack	125	165	12	CR
Patch Failed	126	97	3	MP
Ferrous Element	126	111	4	SP/MP
Ferrous Element	126	147	4	SP/MP
Missing	127	48	30	SP
Patch Failed	127	97	3	MP
Patch Failed	128	97	1	MP
Missing	129	68	10	MP
Stone Crack	129	136	10	CR
Missing	129	198	20	MP
Present	130	7	18	SP
Single Unit	130	113	12	MP
Missing	131	198	18	SP
Patch Failed	132	19	4	MP
Stone Crack	132	136	12	CR
Patch Failed	133	115	3	MP
Patch Failed	134	10	2	MP
Patch Sound	134	87	8	MP
Patch Failed	134	165	30	SP
Missing	134	198	40	DMR
Ferrous Element	135	53	4	SP/MP
Ferrous Element	135	51	4	SP/MP
Patch Sound	135	68	6	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Missing	136	106	4	MP
Missing	136	164	24	SP
Dutchman Sound	136	198	40	DMR
Ferrous Element	137	72	4	MP
Present	138	87	24	SP
Ferrous Element	140	33	4	SP/MP
Patch Sound	141	88	20	DMR
Patch Failed	141	136	2	MP
Dutchman Sound	141	198	40	DMR
Ferrous Element	142	24	4	SP/MP
Patch Sound	142	77	1	MP
Missing	142	107	3	MP
Missing	142	126	3	MP
Present	142	193	17	SP
Patch Sound	143	77	1	MP
Patch Failed	143	97	2	MP
Missing	143	116	4	MP
Missing	143	125	40	DMR
Patch Failed	143	136	8	MP
Patch Failed	144	49	9	MP
Missing	145	165	3	MP
Patch Failed	146	48	6	MNP
Missing	146	107	10	MP
Missing	148	127	24	SP
Stone Crack	150	142	12	CR
Present	150	165	8	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
<b>SOUTH ELEVATION</b>				
Dutchman Failed	171	107	24	DMR
Patch Sound	172	8	4	MP
Crack	172	107	8	SP
Patch Sound	172	145	24	MP
Patch Failed	172	136	8	MP
Patch Failed	173	136	7	MP
Crack	173	175	8	CR
Patch Failed	174	20	4	MP
Patch Failed	174	59	2	MP
Present	174	145	6	MP
Dutchman Sound	174	198	24	DMR
Spall Present	175	40	12	MP
Patch Failed	175	116	8	MP
Patch Failed	175	126	24	SP
Patch Failed	176	126	15	SP
Patch Failed	176	185	16	SP
Patch Failed	177	198	27	DMR
Patch Sound	179	126	10	MP
Patch Failed	179	175	3	MP
Patch Failed	181	136	3	MP
Patch Failed	181	193	7	MP
Patch Sound	182	13	6	MP
Crack	182	175	36	CR
Patch Failed	183	136	12	MP
Patch Failed	183	185	16	SP
Patch Failed	186	98	16	SP
Patch Failed	187	117	36	SP
Patch Failed	188	20	7	MP
Patch Failed	188	49	12	SP
Patch Failed	188	175	18	SP
Patch Failed	188	185	16	SP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Sound	189	8	8	MP
Present	189	20	8	MP
Present	189	59	16	SP
Patch Failed	190	59	10	CR
Crack	190	94	14	CR
Spall Present	195	95	4	MP
Crack	196	77	24	CR
Spall Present	197	40	12	SP/MP
Patch Failed	197	97	13	SP
Patch Failed	197	127	13	SP
Patch Failed	197	136	5	NP
Patch Failed	198	136	2	MP
Patch Failed	198	155	5	MP
Present	199	78	8	MP
Patch Failed	200	164	6	MP
Crack	201	54	12	CR
Patch Failed	201	59	4	MP
Patch Failed	201	127	2	MP
Patch Failed	201	146	4	MP
Patch Failed	201	174	4	MP
Patch Failed	201	185	4	MP
Patch Failed	201	187	6	MP
Patch Failed	204	136	18	SP
Ferrous Element	206	19	4	SP/MP
Dutchman Failed	206	126	44	DMR
Patch Failed	207	40	12	MP
Patch Failed	207	136	20	SP
Dutchman Failed	208	198	48	DMR
Patch Failed	210	127	25	SP
Present	211	86	24	MP
Removed + Steel	213	88	20	MP
Patch Failed	213	107	14	SP
Patch Failed	213	117	48	DMR



DGS PROJECT C-0946-0012 PHASE 004  
INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Missing	213	136	8	SP
Missing	214	59	10	MP
Patch Sound	214	79	10	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
<b>EAST ELEVATION</b>				
Missing	237	48	7	MP
Patch Sound	237	155	20	DMR
Missing	238	48	5	MP
Patch Sound	238	78	40	MP
Removed + Steel	238	88	15	MP
Present	238	97	15	SP
Patch Failed	238	136	40	SP
Dutchman Failed	238	146	20	DMR
Patch Sound	239	68	10	MP
Repair Failed	239	105	15	CR
Patch Sound	241	68	3	MP
Patch Sound	241	155	15	MP
Patch Failed	241	165	15	MP
Present	241	185	10	SP
Patch Failed	242	156	15	SP
Patch Sound	242	165	15	MP
Patch Failed	242	174	10	MP
Patch Failed	242	197	40	DMR
Patch Sound	243	116	3	MP
Patch Failed	243	174	25	SP
Patch Sound	244	146	5	MP
Single Unit	245	164	10	MP
Patch Failed	245	185	10	MP
Patch Sound	246	194	7	MP
Patch Failed	247	146	25	SP
Patch Failed	247	156	15	SP
Patch Failed	247	165	10	MP
Crack	247	170	24	CR
Patch Sound	250	126	40	MP
Patch Failed	250	155	20	SP
Patch Sound	250	156	25	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Failed	250	174	15	SP
Chipped	250	194	2	MP
Patch Failed	252	126	30	SP
Patch Failed	252	194	20	SP
Patch Sound	253	194	10	MP
Crack	254	98	120	CR
Present	255	106	4	MP
Patch Sound	255	174	5	MP
Patch Failed	256	174	15	SP
Patch Failed	256	185	25	SP
Patch Failed	257	194	10	MP
Present	258	174	10	MP
Patch Failed	258	194	15	SP
Dutchman Sound	259	68	25	DMR
Crack	259	109	36	CR
Removed	259	155	20	SP
Dutchman Sound	260	198	25	DMR
Patch Failed	261	165	30	SP
Patch Failed	261	194	10	MP
Patch Failed	262	15	12	MP
Patch Failed	262	146	10	MP
Dutchman Sound	263	198	25	DMR
Patch Failed	264	126	30	SP
Present	264	184	5	MP
Patch Sound	265	48	4	MP
Patch Sound	265	68	7	MP
Patch Failed	265	146	60	DMR
Patch Failed	265	194	10	MP
Patch Failed	266	127	5	MP
Crack	267	95	36	MP
Dutchman Failed	267	198	25	MP
Present	269	107	5	MP
Patch Failed	269	126	10	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Failed	269	155	40	SP
Patch Failed	269	198	60	DMR
Patch Sound	270	194	5	MP
Chipped	271	87	2	MP
Patch Failed	271	107	35	DMR
Present	271	165	15	SP
Present	271	175	10	SP
Patch Failed	273	175	5	MP
Patch Failed	273	185	20	SP
Patch Failed	274	155	5	MP
Patch Failed	275	26	2	MP
Patch Failed	275	174	10	MP
Patch Failed	275	198	40	DMR
Patch Failed	276	184	4	MP
Present	277	86	8	MP
Patch Failed	277	156	10	MP
Patch Failed	277	184	20	SP
Patch Sound	278	88	2	MP
Patch Failed	278	198	30	DMR
Dutchman Failed	280	107	20	SP
Present	280	156	5	MP
Present	281	59	2	MP
Patch Sound	281	156	2	MP
Patch Failed	281	174	25	SP
Present	281	175	5	MP
Crack	282	99	16	CR
Patch Sound	282	117	4	MP
Present	282	119	4	MP
Present	282	121	6	MP
Patch Failed	282	127	4	MP
Patch Failed	282	146	20	SP
Patch Sound	282	175	8	DMR
Patch Sound	283	20	5	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Sound	283	127	10	MP
Patch Sound	284	175	15	MP
Patch Failed	286	165	15	SP
Dutchman Sound	287	146	5	DMR
Patch Failed	287	185	10	MP
Patch Failed	288	165	5	MP
Present	288	185	10	MP
Present	288	198	2	MP
Patch Sound	289	175	15	MP
Patch Failed	289	185	30	DMR
Patch Sound	291	164	10	MP
Patch Failed	292	98	4	MP
Dutchman Failed	292	106	20	SP
Patch Failed	292	136	4	MP
Patch Failed	292	165	20	SP
Patch Failed	292	175	20	SP
Patch Failed	292	184	40	DMR
Repair Failed	292	155	1	CR
Patch Sound	293	127	4	MP
Patch Sound	294	126	10	MP
Patch Failed	294	136	15	SP
Patch Failed	294	146	10	MP
Patch Sound	294	175	5	MP
Dutchman Failed	294	198	40	DMR
Patch Failed	295	175	5	MP
Patch Failed	295	184	5	MP
Chipped	296	9	3	MP
Patch Failed	296	156	10	MP
Present	297	107	10	MP
Patch Failed	298	184	10	MP
Dutchman Sound	298	198	40	MP
Patch Failed	300	184	12	SP
Patch Failed	301	184	10	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Present	302	98	20	SP
Patch Sound	302	126	5	MP
Dutchman Sound	302	146	15	DMR
Patch Failed	302	184	10	MP
Patch Failed	302	194	2	MP
Patch Failed	303	116	4	MP
Dutchman Failed	303	156	15	SP
Patch Failed	303	175	15	SP
Patch Sound	304	78	4	MP
Patch Failed	305	162	9	MP
Patch Failed	305	175	20	SP
Patch Failed	305	184	4	MP
Patch Failed	306	165	5	MP
Patch Failed	306	175	10	SP
Patch Failed	306	184	5	MP
Present	307	29	1	MP
Patch Failed	307	107	5	MP
Patch Failed	307	146	10	MP
Patch Failed	307	164	5	MP
Patch Failed	307	165	5	MP
Patch Failed	308	164	18	MP
Patch Failed	308	198	20	SP
Patch Failed	309	49	4	MP
Repair Sound	309	147	2.098	MP
Patch Failed	311	119	4	MP
Patch Failed	311	116	35	SP
Dutchman Failed	311	174	5	MP
Patch Failed	311	184	36	MP
Patch Failed	312	48	15	SP
Dutchman Sound	313	59	4	DMR
Patch Failed	313	97	15	SP
Patch Failed	313	136	10	MP
Crack	314	174	12	CR

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 ARCHIVES - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Failed	315	116	10	MP
Patch Failed	315	146	25	SP
Patch Failed	316	98	15	SP
Patch Failed	316	155	5	MP

REPAIR LEGEND CODE

- DMR** Dutchman Replacement
- SP** Spall Repair, epoxy adhesive and stainless steel pins
- MP** Repair Mortar Patch
- SP/MP** Spall Repair and Repair Mortar Patch
- CR** Crack Repair, epoxy injection

QUANTITY NOTES

- 1 Patch repairs MP or SP: Quantity is square inches
- 2 Dutchman Repairs DMR: Quantity is square inches
- 3 Crack Repairs CR: Quantity is lineal inches

COLOR KEY



WHITE

Repair to be completed under Project DGS C-0946-0012 P4



Previously completed repair. Shown for reference.

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 2021 MAKE SAFE STUDY UPDATE  
 ARCHIVES - ROOF INSET ELEVATIONS - STONE REPAIR CHART

Condition	X	Y	Amount	Repair Type
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**ROOF INSET ELEVATION LOOKING EAST**

Spall Present	2	199	6	SP
Spall Present	5	194	4	MP
Spall Present	5	199	10	SP/MP
Patch Failed	11	188	4	MP
Patch Failed	11	190	4	SP/MP
Spall Present	17	195	4	MP
Patch Failed	21	190	4	SP/MP
Patch Failed	24	188	6	MP
Patch Failed	29	190	4	SP/MP
Patch Failed	36	190	4	SP/MP
Patch Failed	42	190	4	SP/MP
Patch Failed	49	190	4	SP/MP
Patch Failed	54	189	6	SP
Spall Present	59	188	4	MP
Patch Failed	59	190	4	SP/MP
Patch Failed	62	190	4	SP/MP
Spall Present	63	199	4	MP
Spall Present	65	188	6	MP
Spall Present	65	199	4	MP
Patch Failed	68	190	4	SP/MP
Patch Failed	72	193	48	CR
Stone Crack	72	197	24	CR
Stone Crack	72	189	4	MP



DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 2021 MAKE SAFE STUDY UPDATE  
 ARCHIVES - ROOF INSET ELEVATIONS - STONE REPAIR CHART

Condition	X	Y	Amount	Repair Type
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**ROOF INSET ELEVATION LOOKING WEST**

Spall Present	5	192	8	MP
Stone Crack	10	189	48	CR
Spall Missing	13	188	8	MP
Spall Present	17	195	4	SP
Patch Failed	30	189	8	MP
Spall Missing	33	188	12	MP
Crack	33	189	48	CR
Patch Failed	39	188	8	MP
Spall Present	40	189	4	MP
Patch Failed	40	191	12	SP/MP
Patch Failed	44	189	4	SP/MP
Spall Present	45	188	12	MP
Patch Failed	48	189	8	SP/MP
Crack	50	198	12	CR
Patch Failed	54	188	8	MP
Spall Present	55	188	8	MP
Spall Present	69	199	8	MP
Patch Failed	70	188	8	MP
Crack	70	195	48	CR
Spall Present	75	194	8	MP
Patch Failed	78	194	8	MP

DGS PROJECT C-0946-0012 PHASE 004  
INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
2021 MAKE SAFE STUDY UPDATE  
ARCHIVES - ROOF INSET ELEVATIONS - STONE REPAIR CHART

REPAIR LEGEND CODE

<b>DMR</b>	<b>Dutchman Replacement</b>
<b>SP</b>	<b>Spall Repair, epoxy adhesive and stainless steel pins</b>
<b>MP</b>	<b>Repair Mortar Patch</b>
<b>SP/MP</b>	<b>Spall Repair and Repair Mortar Patch</b>
<b>CR</b>	<b>Crack Repair, epoxy injection</b>

QUANTITY NOTES

- 1 Patch repairs MP or SP: Quantity is square inches**
- 2 Dutchman Repairs DMR: Quantity is square inches**
- 3 Crack Repairs CR: Quantity is lineal inches**

COLOR KEY



**Repair to be completed under Project DGS C-0946-0012 P4**



**Previously completed repair. Shown for reference.**

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
<b>EAST ELEVATION</b>				
Patch Sound	295	97	24	MP
Present	298	81	12	SP
Present	298	84	10	MP
Dutchman Failed	299	39	48	SP
Repair Sound	299	45	24	MP
Dutchman Sound	300	39	48	DMR
Patch Sound	305	81	10	MP
Present	307	28	12	SP
Patch Sound	307	47	10	MP
Missing	307	84	16	SP
Rust	308	40	4	SP/MP
Present	309	40	24	CR
Present	311	81	8	MP
Repair Failed	314	40	36	CR
Single Unit	316	28	30	CR
Patch Failed	317	39	18	SP
Present	318	47	18	CR
Present	319	38	20	MP
Patch Sound	319	84	8	MP
Patch Failed	321	54	4	MP
Missing	323	94	2	MP
Present	325	38	8	SP
Present	325	40	18	CR
Present	327	66	8	SP
Present	328	46	24	CR
Patch Sound	328	98	30	MP
Present	329	37	20	SP
Patch Failed	329	40	12	CR
Patch Failed	330	39	12	SP
Patch Failed	330	47	12	SP
Patch Failed	332	40	12	CR

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Repair Sound	334	39	36	CR
Patch Failed	335	52	36	CR
Patch Sound	336	84	32	MP
Patch Failed	337	40	12	CR
Patch Sound	337	84	32	MP
Patch Failed	338	66	24	SF
Chipped	339	97	12	MP
Repair Failed	342	66	12	CR
Repair Sound	342	85	24	CR
Patch Failed	343	57	12	MP
Repair Failed	346	66	24	CR
Patch Failed	353	38	24	MP
Repair Failed	354	36	24	CR
Repair Failed	354	39	36	CR
Present	355	38	36	SP
Rust	356	93	4	SP/MP
Missing	356	97	48	SP/MP
Repair Failed	358	65	4	CR
Dutchman Failed	359	38	9	DMR
Patch Failed	360	50	12	MP
Patch Failed	360	55	12	MP
Patch Failed	360	57	16	MP
Dutchman Failed	360	74	6	MP
Patch Failed	360	84	18	SP
Crack	361	98	3	CR
Exfoliation	362	85	6	MP
Patch Failed	364	57	4	MR
Patch Failed	368	65	16	MP
Patch Failed	368	84	18	SP
Patch Failed	371	91	6	MP
Repair Failed	372	44	12	CR
Patch Failed	373	42	24	SP
Single Unit	374	35	12	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Present	374	40	12	MP
Repair Sound	375	90	12	CR
Missing + Steel	377	28	256	DMR
Present	378	37	24	CR
Repair Failed	378	47	10	CR
Single Unit	379	29	6	CR
Present	380	38	36	SP/MP
Repair Failed	380	57	22	CR
Repair Sound	380	84	64	MP
Missing	382	28	6	MP
Patch Failed	385	67	12	MP
Patch Sound	389	84	60	MP
Patch Failed	390	47	24	SP
Patch Failed	390	65	48	SP
Single Unit	393	29	30	CR
Dutchman Failed	394	56	2	MP
Repair Failed	397	39	36	CR
Repair Failed	397	42	12	CR
Patch Sound	401	100	20	MP
Patch Failed	403	28	9	MP
Chipped	404	39	8	MP
Repair Failed	405	65	32	SP
Patch Failed	409	65	24	SP
Patch Failed	410	27	40	SP
Patch Sound	410	83	10	MP
Repair Failed	412	65	18	SP
Patch Failed	414	38	12	MP
Patch Sound	415	83	10	MP
Repair Failed	415	86	24	SP
Repair Failed	416	38	15	CR
Repair Failed	416	43	12	CR
Patch Sound	416	83	4	MP
Patch Failed	416	99	(2) @ 72	DMR

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Repair Failed	417	42	18	MP
Present	421	27	2	MP
Present	424	97	36	SP/MP
Repair Failed	428	38	8	CR
Patch Sound	428	65	15	MP
Present	429	54	2	MP
Repair Failed	430	28	24	CR
Repair Failed	431	42	19	CR
Patch Failed	433	72	6	MP
Repair Failed	434	41	8	CR
Spall	434	41	10	MP
Present	435	29	32	SP
Repair Failed	435	38	8	CR
Repair Failed	437	44	4	CR
Repair Failed	437	72	6	CR
Repair Sound	437	95	32	CR
Stone Crack	438	27	24	CR
Repair Failed	438	62	4	CR
Present	438	80	2	MP
Repair Sound	439	83	24	MP
Patch Sound	439	96	40	MP
Patch Sound	441	65	20	MP
Present	441	97	48	MP
Stone Crack	442	25	15	CR
Patch Failed	442	34	10	MP
Patch Sound	442	85	16	MP
Repair Failed	443	39	4	MP
Patch Failed	443	46	6	MP
Patch Failed	443	57	8	MP
Repair Failed	443	75	6	CR
Patch Sound	443	84	16	MP
Repair Failed	443	92	4	MP
Patch Failed	446	58	8	MP

DGS PROJECT C-0946-0012 PHASE 004  
INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Failed	447	28	9	MP
Repair Failed	447	28	8	CR

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
<b>NORTH ELEVATION</b>				
Repair Failed	550	29	6	CR
Present	551	35	24	CR
Patch Sound	554	36	8	MP
Repair Sound	555	84	12	MP
Repair Failed	557	84	18	MP
Patch Failed	559	25	400	SP
Repair Sound	559	84	36	C
Patch Sound	561	91	25	MP
Patch Sound	564	84	15	MP
Patch Failed	565	29	32	MP
Repair Sound	565	84	8	CR
Patch Sound	565	97	30	MP
Patch Failed	566	25	300	SP
Missing	567	28	50	SP
Crack	569	45	48	CR
Crack	569	51	8	CR
Present	570	46	12	MP
Patch Sound	571	83	12	MP
Patch Sound	572	83	16	MP
Patch Sound	573	74	9	MP
Present	575	51	36	CR
Patch Failed	575	52	12	MP
Missing	580	24	10	MP
Patch Failed	581	24	80	SP
Crack	582	30	48	CR
Repair Sound	590	47	12	SP/MP
Patch Failed	591	25	600	SP
Patch Sound	591	98	18	MP
Repair Sound	592	85	12	CR
Crack	594	74	18	CR
Crack	595	87	48	CR



DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Sound	597	65	40	MP
Repair Failed	599	25	3	CR
Present	600	55	4	MP
Patch Sound	600	64	32	MP
Repair Failed	601	27	24	CR
Present	601	42	10	CR
Repair Failed	602	24	6	MP
Patch Failed	602	25	20	SP
Patch Failed	602	26	24	SP
Rust	602	26	4	MP
Present	602	39	4	MP
Patch Sound	602	46	60	MP
Patch Failed	603	24	40	SP
Repair Failed	604	24	4	MP
Dutchman Failed	604	24	72	DMR
Present	605	47	20	MP
Patch Failed	606	24	20	MP
Repair Failed	608	24	12	SP
Repair Failed	608	25	10	CR
Repair Failed	610	24	4	CR
Repair Failed	613	34	8	CR
Patch Sound	613	96	6	MP
Repair Failed	614	26	6	CR
Patch Failed	614	64	3	MP
Present	614	75	4	MP
Repair Failed	615	25	15	CR
Patch Sound	615	74	4	MP
Missing	618	76	4	MP
Repair Failed	621	25	20	CR
Present	623	54	36	CR
Repair Sound	624	91	16	CR
Patch Sound	625	97	16	MP
Repair Failed	626	25	6	CR

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Sound	626	91	24	MP
Repair Failed	629	24	36	CR
Patch Failed	631	27	12	MP
Patch Sound	631	83	5	MP
Repair Failed	633	28	12	CR
Missing	634	27	6	MP
Patch Sound	635	97	8	MP
Repair Failed	636	25	30	SP
Repair Failed	643	36	10	MP
Patch Sound	643	97	2	MP
Repair Failed	644	26	12	CR
Repair Failed	644	36	12	CR
Repair Failed	644	64	64	CR
Repair Sound	645	25	12	CR
Repair Failed	645	27	12	CR
Crack	645	55	36	CR
Repair Sound	646	82	30	CR
Repair Failed	647	26	4	CR
Crack	647	75	48	CR
Repair Failed	648	25	15	N
Missing	649	22	12	CR
Present	649	25	24	CR
Repair Sound	650	75	6	MP
Repair Failed	651	25	30	CR
Repair Sound	651	76	8	MP
Repair Failed	651	89	12	MP
Present	652	30	4	MP
Repair Failed	652	47	2	MP
Present	653	76	24	CR
Present	653	76	2	MP
Repair Failed	655	24	18	CR
Crack	655	45	12	CR
Crack	655	93	10	CR

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Dutchman Sound	656	46	10	DMR
Repair Failed	656	61	6	CR
Repair Sound	657	83	5	CR
Patch Sound	657	97	16	MP
Repair Sound	658	83	9	CR
Present	659	97	10	MP
Repair Sound	662	83	9	CR
Patch Sound	663	46	24	SP/MP
Missing	665	23	50	SP
Patch Sound	665	87	36	MP
Repair Failed	666	62	8	CR
Repair Failed	668	65	18	CR
Repair Failed	670	24	24	CR
Missing	670	31	12	SP
Repair Failed	670	46	48	SP
Spall	671	28	10	SP
Patch Failed	671	64	3	MP
Patch Failed	672	27	3	MP
Repair Failed	672	29	10	CR
Repair Failed	674	46	20	CR
Repair Sound	674	97	72	DMR
Repair Failed	675	26	36	CR
Patch Failed	676	64	6	MP
Patch Failed	681	26	5	MP
Patch Failed	681	27	4	MP
Present	682	91	16	SP
Repair Failed	684	28	8	CR
Repair Failed	684	29	12	CR
Repair Failed	685	24	12	CR
Repair Sound	685	27	16	MP
Repair Failed	687	25	4	CR
Repair Failed	687	28	15	CR
Crack	687	97	36	CR

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Repair Failed	688	24	36	CR
Patch Sound	688	96	32	MP
Repair Failed	690	27	12	CR
Repair Sound	690	95	72	CR
Patch Sound	692	97	2	MP
Repair Failed	693	26	8	CR
Crack	694	94	36	CR
Repair Failed	697	46	80	CR
Patch Failed	699	61	2	MP
Repair Failed	700	24	24	CR
Repair Failed	700	27	8	CR
Repair Failed	702	24	36	CR
Repair Sound	702	47	12	CR
Repair Sound	702	96	16	MP
Repair Failed	705	24	24	CR

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
<b>WEST ELEVATION</b>				
Patch Failed	813	24	36	CR
Patch Failed	813	26	11	MP
Patch Failed	814	57	12	MP
Patch Failed	814	58	12	MP
Patch Failed	816	27	12	MP
Patch Failed	816	57	3	MP
Patch Sound	816	87	3	MP
Patch Sound	818	74	5	MP
Patch Sound	818	84	14	SP
Patch Failed	820	26	16	CR
Patch Failed	824	26	24	SP
Present	827	46	4	MP
Patch Failed	827	57	12	MP
Patch Failed	827	97	32	DMR
Patch Failed	829	27	6	MP
Patch Failed	829	38	12	MP
Patch Failed	829	46	16	SP
Patch Sound	829	83	16	MP
Present	835	97	12	MP
Patch Sound	835	97	32	CR
Patch Failed	836	26	12	CR
Present	836	93	12	MP
Patch Sound	837	27	12	MP
Present	843	83	9	MP
Patch Sound	843	97	72	DMR
Patch Failed	844	27	4	MP
Patch Failed	845	27	12	CR
Present	845	80	6	MP
Crack	845	80	18	CR
Patch Sound	846	97	4	MP
Patch Sound	847	97	4	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Failed	848	28	12	MP
Patch Sound	848	97	4	MP
Present	849	33	12	SP
Patch Failed	849	38	12	MP
Patch Sound	849	97	6	DMR
Missing	852	26	72	SP
Patch	852	26	36	CR
Present	854	26	28	SP
Patch Failed	854	27	12	CR
Present	855	97	16	CR
Present	856	84	12	SP
Patch Failed	858	45	12	MP
Present	861	60	84	CR
Patch Failed	866	27	11	MP
Present	868	43	4	MP
Patch Failed	868	45	5	MP
Crack	868	94	12	CR
Patch Sound	869	97	48	MP
Patch Failed	871	16	4	MP
Patch Failed	871	23	4	MP
Patch Failed	871	26	36	CR
Patch Failed	873	28	12	CR
Present	873	97	48	CR
Patch Failed	878	26	19	CR
Patch Failed	878	28	12	CR
Patch Failed	878	97	12	MP
Patch Sound	881	97	12	MP
Missing	885	97	72	SP
Patch Failed	886	27	18	CR
Crack	886	84	3	CR
Patch Failed	887	26	8	CR
Patch Failed	887	97	24	SP
Patch Failed	889	97	9	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Crack	890	27	12	CR
Patch Failed	891	28	12	MP
Patch Failed	891	97	24	SP
Patch Failed	892	16	4	MP
Missing	892	23	4	MP
Patch Failed	892	26	22	CR
Crack	893	11	24	CR
Patch Failed	893	26	8	MP
Patch Failed	893	28	10	MP
Patch Failed	893	38	12	MP
Patch Failed	897	45	4	MP
Crack	897	70	48	CR
Missing	899	25	30	SP
Patch Failed	901	27	12	MP
Patch Failed	908	31	12	MP
Patch Failed	909	40	12	MP
Patch Failed	909	41	6	MP
Crack	909	70	48	CR
Repair Failed	912	26	12	MP
Patch Failed	912	45	8	MP
Repair Sound	913	28	10	MP
Patch Failed	915	27	8	MP
Patch Sound	916	47	24	DMR
Patch Failed	917	27	15	MP
Patch Failed	917	27	10	CR
Ferrous Element	917	91	18	MP
Patch Failed	920	35	12	MP
Patch Sound	920	90	66	MP
Patch Failed	925	26	12	MP
Patch Failed	925	26	12	CR
Patch Failed	926	25	10	MP
Repair Failed	926	27	18	CR
Repair Failed	927	72	6	CR

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Present	928	26	8	MP
Present	928	47	9	MP
Patch Sound	929	100	9	DMR
Repair Failed	932	22	24	CR
Repair Failed	932	25	36	CR
Present	933	29	8	SP
Missing	936	45	16	MP
Repair Failed	937	28	18	CR
Repair Failed	938	57	5	CR
Patch Sound	938	100	12	MP
Patch Failed	940	62	8	MP
Crack	941	32	48	CR
Ferrous Element	947	90	12	MP
Crack	951	28	12	CR
Patch Sound	951	29	64	CR
Patch Sound	951	29	30	SP/MP
Patch Failed	953	27	64	MP
Repair Failed	954	27	12	SP
Repair Failed	955	49	36	CR
Patch Failed	956	47	12	MP
Repair Sound	956	90	12	CR
Removed	958	63	24	MP
Repair Failed	963	76	30	CR
Present	965	24	16	MP
Repair Sound, Crack	965	27	12, 12	CR
Repair Failed	966	26	12	CR
Crack	966	28	12	CR
Present	966	37	12	SP
Repair Failed	967	25	72	CR
Repair Failed	967	25	36	CR



DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
<b>SOUTH ELEVATION</b>				
Repair Failed	1099	24	12	CR
Repair Failed	1102	26	18	CR
Repair Failed	1102	27	22	CR
Repair Failed	1103	24	30	CR
Repair Failed	1103	27	15	CR
Patch Failed	1104	37	8	MP
Repair Sound	1104	97	32	CR
Missing	1105	25	4	SP
Repair Failed	1105	36	8	MP
Repair Failed	1105	37	12	MP
Repair Sound	1105	76	24	CR
Repair Sound	1105	77	24	CR
Repair Failed	1106	26	24	CR
Patch Failed	1106	34	3	MP
Patch Sound	1106	36	12	MP
Repair Failed	1106	49	60	CR
Repair Sound	1106	74	18	CR
Repair Failed	1108	25	18	CR
Repair Failed	1108	26	18	CR
Present	1111	62	72	CR
Repair Sound	1111	94	24	CR
Repair Failed	1112	96	36	CR
Repair Failed	1115	25	12	CR
Repair Failed	1116	24	18	CR
Missing	1117	28	36	SP
Repair Failed	1117	28	18	CR
Repair Failed	1119	24	20	CR
Repair Failed	1119	45	12	CR
Repair Failed	1121	46	10	CR
Repair Failed	1122	24	12	CR
Repair Failed	1122	27	2	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Repair Failed	1123	27	12	CR
Present	1123	65	9	MP
Repair Sound	1124	61	12	DMR
Repair Sound	1124	97	24	CR
Repair Failed	1125	26	64	CR
Repair Failed	1126	27	4	CR
Patch Sound	1127	46	46	MP
Repair Sound	1129	97	36	CR
Present	1130	30	12	SP
Repair Failed	1130	31	24	CR
Present	1130	38	12	MP
Patch Sound	1130	86	27	MP
Repair Sound	1132	97	9	CR
Repair Failed	1133	26	12	CR
Patch Failed	1133	70	2	MP
Repair Failed	1135	27	12	CR
Patch Failed	1136	61	6	MP
Patch Failed	1137	27	8	MP
Repair Sound	1137	29	4	MP
Repair Failed	1138	27	18	CR
Patch Failed	1139	24	3	MP
Dutchman Failed	1139	46	4	SP
Patch Sound	1139	83	12	MP
Patch Failed	1140	29	10	MP
Repair Failed	1141	28	12	CR
Present	1142	25	18	CR
Patch Sound	1142	85	5	MP
Present	1143	28	22	CR
Patch Sound	1143	89	6	MP
Repair Failed	1145	24	24	CR
Repair Failed	1145	28	30	MP
Present	1145	47	24	SP
Patch Failed	1145	47	48	CR

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Repair Sound	1146	27	20	SP
Repair Sound	1146	28	30	SP
Patch Failed	1147	27	12	MP
Repair Failed	1150	46	12	CR
Repair Failed	1153	28	8	CR
Repair Failed	1153	30	8	CR
Patch Sound	1154	26	16	MP
Crack	1154	33	24	CR
Patch Sound	1154	77	12	MP
Repair Failed	1154	87	9	MP
Dutchman Sound	1154	99	24	DMP
Present	1115	28	6	MP
Patch Failed	1155	69	8	MP
Patch Failed	1155	87	6	MP
Missing	1157	52	4	MP
Missing	1158	26	40	MP
Missing	1160	27	40	MP
Repair Sound	1160	27	36	CR
Patch Failed	1160	47	12	MP
Repair Sound	1161	25	30	CR
Repair Sound	1161	25	80	MP
Patch Failed	1161	29	12	CR
Repair Failed	1163	23	18	CR
Missing	1163	26	10	SP
Present	1163	83	6	MP
Repair Sound	1163	87	14	CR
Missing	1163	89	12	MP
Present	1164	92	12	MP
Present	1165	89	12	MP
Repair Sound	1166	87	18	MP
Repair Sound	1168	24	18	MP
Repair Sound	1167	97	24	SP
Repair Failed	1168	24	18	CR

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Repair Sound	1168	27	9	MP
Crack	1168	97	8	CR
Present	1172	64	4	SP
Crack	1174	27	48	CR
Repair Failed	1175	28	3	MP
Repair Failed	1176	24	12	CR
Patch Sound	1176	84	9	MP
Missing	1177	27	14	MP
Repair Failed	1178	27	8	CR
Repair Failed	1178	27	12	MP
Present	1178	87	9	MP
Crack	1179	26	24	CR
Patch Failed	1183	24	30	MP
Repair Failed	1183	25	30	CR
Crack	1184	86	48	CR
Patch Sound	1185	82	12	MP
Single Unit	1186	24	4	CR
Patch Sound	1188	96	6	MP
Patch Failed	1189	65	10	MP
Repair Failed	1190	64	12	CR
Paint	1193	29	24	CP
Present	1195	46	70	CR
Patch Sound	1196	28	20	MP
Crack	1200	52	72	CR
Missing	1202	96	18	MP
Patch Failed	1204	26	12	MP
Patch Failed	1204	70	9	DMR
Missing	1205	27	16	MP
Patch Failed	1206	26	2	MP
Patch Failed	1206	27	40	MP
Present	1207	27	16	SP
Patch Failed	1208	27	12	MP
Spall	1209	27	12	SP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Crack	1210	26	12	SP
Present	1210	27	18	SP
Crack	1220	25	12	CR
Patch Failed	1222	33	12	MP
Present	1222	96	4	MP
Patch Sound	1223	27	24	SP/MP
Patch Failed	1224	26	18	CR
Patch Sound	1227	78	12	MP
Missing	1228	27	15	MP
Patch Failed	1228	46	4	MP
Patch Sound	1228	75	12	MP
Missing	1228	96	6	MP
Missing	1228	98	20	MP
Patch Failed	1229	48	12	MP
Repair Failed	1231	31	12	CR
Patch Sound	1232	97	2	MP
Repair Failed	1236	44	12	CR
Patch Failed	1239	47	160	DMR
Patch Failed	1240	27	5	MP
Repair Failed	1241	27	12	MP
Single Unit	1241	83	5	CR
Patch Failed	1241	100	9	MP
Missing	1242	47	32	MP
Missing	1243	100	5	SP/MP
Patch Sound	1245	47	15	MP
Patch Sound	1245	59	15	MP
Patch Sound	1245	80	9	MP
Missing	1245	100	10	MP
Patch Failed	1246	60	12	MP
Patch Sound	1246	65	15	MP
Patch Sound	1246	99	15	MP
Single Unit	1247	55	16	SP
Patch Sound	1247	89	16	MP

DGS PROJECT C-0946-0012 PHASE 004  
 INFRASTRUCTURE RENOVATIONS & UPGRADES STATE MUSEUM & ARCHIVES  
 HARRISBURG, DAUPHIN COUNTY, PENNSYLVANIA  
 MUSEUM - STONE REPAIRS CHART

Condition	X	Y	Amount	Repair Type
Patch Failed	1250	33	2	MP
Patch Failed	1250	65	2	MP
Patch Sound	1252	78	.5	MP
Patch Sound	1252	83	1	MP
Patch Failed	1252	98	64	DMR
Patch Failed	1254	99	25	DMR
Missing	1255	28	64	MP
Single Unit	1256	94	13	CR
Patch Sound	1257	45	16	MP

REPAIR LEGEND CODE

- DMR Dutchman Replacement
- SP Spall Repair, epoxy adhesive and stainless steel pins
- MP Repair Mortar Patch
- SP/MP Spall Repair and Repair Mortar Patch
- CR Crack Repair, epoxy injection
- CP Clean Paint

QUANTITY NOTES

- 1 Patch repairs MP or SP: Quantity is square inches
- 2 Dutchman Repairs DMR: Quantity is square inches
- 3 Crack Repairs CR: Quantity is lineal inches

COLOR KEY

- WHITE Repair to be completed under Project DGS C-0946-0012 P4
- Previously completed repair. Shown for reference.

## SECTION 040141

### CLEANING OF STONE ASSEMBLIES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes maintenance of select stone assemblies consisting of stone restoration and cleaning as follows:
  - 1. Cleaning exposed Alabama limestone surfaces at the Museum and former Archives for areas as indicated on drawings.
- B. Related Sections:
  - 1. Section 016200 "Historical and Museum Supplemental Provisions" for list of Client Agency prequalified masonry restoration contractors. The work of this section must be performed by a pre-qualified contractor listed in Section 016200.
  - 2. Section 040140 "Maintenance of Stone Assemblies" for repair of stone failures.

##### 1.3 DEFINITIONS

- A. Stone Terminology: ASTM C 119.
- B. Face Bedding: Setting of stone with the natural bedding planes (strata) vertical and parallel to the wall plane rather than horizontal or "naturally bedded," which holds bedding planes together by gravity.

##### 1.4 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI), [www.ansi.org](http://www.ansi.org).
- B. ANSI Z136.1 Safe Use of Lasers.
- C. ANSI Z136.6 Safe Use of Lasers Outdoors.

##### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.

- B. Qualification Data: For restoration specialists, including field supervisors and restoration workers and chemical-cleaner manufacturer.
- C. Quality-Control Program.
- D. Cleaning Program.
  - 1. Include the following:
    - a. List of laser cleaning equipment that will be used.
    - b. Documentation confirming contractor's personnel have been properly trained by the equipment manufacturer.
- E. Contractor shall submit documentation confirming the laser supplier and equipment proposed for the project meets the specified requirements.

#### 1.6 QUALITY CONTROL

- A. Restoration Specialist Qualifications: Engage an experienced stone cleaning firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience installing standard unit masonry or new stone masonry is not sufficient experience for stone restoration work.
  - 1. Cleaning work shall be performed by the same specialist firm performing the repair work.
  - 2. Field Supervision: Restoration specialist firms shall maintain experienced full-time supervisors on Project site during times that stone restoration and cleaning work is in progress. Supervisors shall not be changed during Project except for causes beyond control of restoration specialist firm.
  - 3. Restoration Worker Qualifications: Persons who are experienced and specialize in restoration work of the type they will be performing.
- B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage due to worker fatigue.
- C. Cleaning Program: Prepare a written cleaning program that describes the cleaning process in detail, including materials, methods, and equipment to be used, protection of surrounding materials, and control of runoff during operations.
  - 1. If materials and methods other than those indicated are proposed for any phase of restoration work, add to the Quality-Control Program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project and worker's ability to use such materials and methods properly.
  - 2. Coordinate the cleaning program to be commenced after all repairs are complete.
- D. Cleaning and Repair Appearance Standard: Cleaned and repaired surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Professional. Perform additional paint and stain removal, general cleaning, and spot cleaning of small areas that are noticeably different, so that surface blends smoothly into surrounding areas.



- E. Mockups: Prepare mockups of restoration and cleaning to demonstrate aesthetic effects and set quality standards for materials and execution and for fabrication and installation.
1. Job Reference Standard: The laser operator shall prepare a laser cleaned sample area, or areas, where directed. It shall be of consistent and uniform appearance when the surface is viewed without magnification according to the degree of surface cleaning approved by the Professional. Following acceptance by the Professional, the prepared sample shall serve as a Job Reference Standard (JRS). The JRS shall be documented and preserved to serve as a reference for the duration of the project, and all documentation shall be retained as part of the project records. The laser system used for the JRS shall be the same unit used for the entire project unless otherwise approved in writing.
  2. Cleaning: Clean an area of approximately 50 sq. ft. Provide two mockups; one at the Archives and one at the Museum. The Professional will select the areas to serve as the JRSs.
    - a. Test methods on samples of adjacent materials for possible adverse reactions. Do not use methods known to have deleterious effect.
    - b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.
  3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Professional specifically approves such deviations in writing.
  4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to stone restoration and cleaning including, but not limited to, the following:
    - a. Construction Schedule: Verify availability of materials, Restoration Specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
    - b. Materials, material application, sequencing, tolerances, and required clearances.
- G. Handheld Laser Cleaning Equipment Supplier Qualifications:
1. Past history of performance: The laser cleaning equipment utilized for the project shall be provided by a company with the following:
    - a. A minimum of 10 years of experience manufacturing laser systems specifically designed for handheld precise cleaning applications.
    - b. A resume of success with historic architectural stone cleaning projects consisting of at least 5 major projects.
    - c. Technically qualified personnel available by phone or, if required, onsite, within a reasonable time to respond to equipment operating issues, malfunctions or damage.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

## 1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit stone restoration and cleaning work to be performed according to manufacturers' written instructions and specified requirements.
- B. Clean stone surfaces only when air temperature is 40 deg F (4 deg C) and above and is predicted to remain so for at least 7 days after completion of cleaning.

## 1.9 COORDINATION

- A. Coordinate stone restoration and cleaning with public circulation patterns at Project site. Some work is near public circulation patterns. Public circulation patterns cannot be closed off entirely, and in places can be only temporarily redirected around small areas of work. Plan and execute the Work accordingly.

## 1.10 SEQUENCING AND SCHEDULING

- A. Coordinate with stone restoration work specified in Section 040140 "Maintenance of Stone Assemblies."
- B. Perform stone restoration and cleaning work in the following sequences:
  - 1. Repair stonework, including replacing existing stone with new stone.
  - 2. Rake out mortar from joints to be repointed.
  - 3. Point mortar and sealant joints.
  - 4. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
  - 5. Inspect for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
  - 6. Clean stone surfaces per this section.

## PART 2 - PRODUCTS

### 2.1 CLEANING APPARATUS

- A. Laser Technology: High-powered laser cleaning equipment designed to clean surfaces such as natural stone, metal, etc., by sending nano-pulses of infrared light to the surface heating up the dirt and contaminants instantly causing rapid thermal expansion, which in turn causes the dirt to lift off the surface.
- B. Laser Equipment Supplier Requirements:
  - 1. Provide onsite technical support specialist, consisting of an experienced, well-qualified individual with background in the laser cleaning of historic architectural stone, at project start-up and on an as needed basis during the project.
  - 2. Equipment and supplies shall consist of the following minimum items:

- a. Laser System: Portable unit designed specifically for precise cleaning applications with a scanning type handheld end effector/laser optic that includes adjustments for pulse frequency, scan frequency and scan width, including optical cleaning supplies, replacement protection windows (if applicable) with commonly needed spare parts available in stock at the supplier for quick delivery.
- b. Laser Safety Eyewear: Laser safety eyewear with specifications necessary for the laser type, wavelength and laser beam parameters, in sufficient quantity for the laser operators, supervisor, as well as inspectors, Professional, Client Agency and Department.
- c. Laser Safety Curtains: Laser safety curtains or other suitable, non-flammable, beam blocking materials in a sufficient quantity, size/configuration to create a temporary laser-controlled area (TLCA) that will mitigate the risk of hazardous unintended beam exposure to personnel within the nominal ocular hazard distance of the laser system being used.
- d. Laser Safety Signage: Per ANSI Z136.1.
- e. Laser Fume Extractor Filter Unit: Laser fume extractor filter unit to point source capture laser generated airborne contaminants to mitigate the risk of exposure to portable unit designed to point source capture laser cleaning effluent/fumes at the source through a nozzle and suction hose and to process all such fumes through filters that includes high efficiency particulate air (HEPA) filtration and carbon filtration so that the cleaning process does not release potentially hazardous vapors and particles referred to as laser generated airborne contaminants.

C. Manufacturers: Acceptable laser equipment manufacturers include the following:

- 1. GC Laser Systems.
- 2. Adapt Laser.
- 3. Or other manufacturer as approved by the Professional.

## PART 3 - EXECUTION

### 3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from stone restoration work.
  - 1. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of restoration and cleaning work.

### 3.2 BEFORE COMMENCING WORK

- A. Laser Safety: The laser cleaning work shall comply with all applicable regulatory requirements for the use of Class 4 laser systems, and per ANSI Z136.1 and ANSI Z136.6, for the operation, including the technical measures, administrative procedures and personal protective equipment (PPE) as required to protect personnel and property from hazardous laser beam exposure. Prior to execution of all laser ablation surface preparation activities, the scope of work shall be assessed to determine minimal laser safety requirements. The laser work area shall be isolated by specially rated laser safety curtains to provide a TLCA according to ANSI Z136.1, including laser safety signage, to limit entry/access by other personnel and mitigate the potential for stray laser beam exposure. Prior to activating the laser beam, the laser operator shall ensure all safety precautions are in place and that everyone within the TLCA is wearing the appropriate PPE consisting of specific laser safety eyewear at a minimum.

- B. Product Safety: All contractor personnel operating laser equipment shall be familiar with the Project Safety Plan, including laser safety training and procedures.
  - 1. Laser safety must be the highest priority, along with all other project hazard control requirements.
  - 2. Only formally trained personnel may operate the laser system when under the supervision of a person trained in laser safety.
  - 3. Always use the gentlest beam settings possible that will provide the desired results.
- C. Training: Operators and supervisors shall receive formal, documented training by qualified personnel on laser safety according to regulatory requirements, as well as the laser equipment provider/OEM on the use and care of the laser, including related equipment. All trained operators shall possess credentials such as a certificate of completion or ID card provided by a qualified training instructor.

### 3.3 CLEANING STONE, GENERAL

- A. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water, if used, will not wash over cleaned, dry surfaces.
- B. Clean stone surfaces with laser equipment per procedures used for approved mockup JRS as required to achieve results as approved by the Professional.
  - 1. The drawings indicate the areas to be cleaned. The intent was to clean the most heavily soiled stone surfaces.
  - 2. Clean stone surfaces within areas indicated.
    - a. "Feather" cleaning at the perimeter of areas indicated to be cleaned to blend into the color of adjacent areas not indicated to be cleaned.

### 3.4 FIELD QUALITY CONTROL

- A. Inspection: Contractor shall engage qualified supervisory staff to perform continuous inspections of cleaning work.
- B. Professional's Project Representatives: Professional will assign Project representatives to help carry out Professional's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Professional's Project representatives use of lift devices, scaffolding and provide required fall protection equipment, as needed, to observe progress and quality of portion of the Work completed.

END OF SECTION 040141

## SECTION 042200

### CONCRETE UNIT MASONRY

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Concrete masonry units.
  - 2. Mortar and grout.
  - 3. Steel reinforcing bars.
  - 4. Masonry joint reinforcement.
  - 5. Ties and anchors.
  - 6. Miscellaneous masonry accessories.

##### 1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

##### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection:
  - 1. Weep holes/vents.
- C. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
  - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Professional and approved in writing.
- D. Qualification Data: For testing agency.
- E. Material Certificates: For each type and size of the following:

1. Masonry units.
    - a. Include data on material properties.
  2. Cementitious materials. Include brand, type, and name of manufacturer.
  3. Pre-blended, dry mortar mixes. Include description of type and proportions of ingredients.
  4. Grout mixes. Include description of type and proportions of ingredients.
  5. Reinforcing bars.
  6. Joint reinforcement.
  7. Anchors, ties, and metal accessories.
- F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
  2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- G. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

#### 1.5 QUALITY CONTROL

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

- D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.7 PROJECT CONDITIONS

- A. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.

## PART 2 - PRODUCTS

### 2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

### 2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa).
  - 2. Density Classification: Normal weight.
  - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
- C. Concrete Building Brick: ASTM C 55.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.31 MPa).
  - 2. Density Classification: Normal weight.
  - 3. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.

## 2.3 CONCRETE AND MASONRY LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

## 2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Aggregate for Mortar: ASTM C 144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints less than 1/4-inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
  - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
  - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- E. Aggregate for Grout: ASTM C 404.
- F. Water: Potable.

## 2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
  - 1. Interior Walls: Mill-galvanized, carbon steel.
  - 2. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
  - 3. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
  - 4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
  - 5. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.



## 2.6 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.
  2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
  3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
  4. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.
- B. Partition Top anchors: 0.105-inch- (2.66-mm-) thick metal plate with 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel.
- C. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

## 2.7 MISCELLANEOUS ANCHORS

- A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- B. Post-installed Anchors: Torque-controlled expansion anchors or chemical anchors.
1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.

## 2.8 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
  2. Use portland cement-lime mortar unless otherwise indicated.
- B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion or Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
  - 1. For interior non-load-bearing partitions, use Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
  - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  - 2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
  - 3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

#### 3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
  - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
  - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4-inch (6 mm) in a story height or 1/2 inch (12 mm) total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12 mm) maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12 mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  1. Install compressible filler in joint between top of partition and underside of structure above.
  2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
  1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

### 3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
  1. Space reinforcement not more than 16 inches (406 mm) o.c.
  2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
  3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at [corners,] returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### 3.7 LINTELS

- A. Provide concrete or masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

### 3.8 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for compressive strength.
- G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- H. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

### 3.9 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Professional's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

### 3.10 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 042200

SECTION 055000  
METAL FABRICATIONS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:
  - 1. Ladders for elevator pits.
  - 2. Guard rails for catwalks at ceiling plenum area above Memorial Hall.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design catwalk guard rail system, including comprehensive engineering analysis by qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Catwalk Guard Rail System: Catwalk guard rail system shall withstand the effects of loads and stresses within limits and under conditions specified in ICC's International Building Code, except as noted below:
  - 1. It is the intent to meet the guard rail loading criteria prescribed by the IBC; however, the guard sections must be lightweight and removable. In the event there is a conflict between loading requirements and removability, the Contractor shall advise the Professional.

1.4 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal fabrications.
  - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- B. Qualification Data: For qualified professional engineer.
- C. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- D. Welding certificates.

- E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the Commonwealth of Pennsylvania responsible for their preparation.

#### 1.5 QUALITY CONTROL

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

#### 1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

### PART 2 - PRODUCTS

#### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

#### 2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

#### 2.3 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.



- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

## 2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners.
  - 1. Provide stainless-steel fasteners for metal fabrication.
- B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1) Group 2 (A4).
- C. Post-Installed Anchors: Chemical anchors.
  - 1. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) Group 2 (A4) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 099123 Interior Painting."
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, non-corrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

## 2.7 METAL LADDERS

### A. General:

1. Comply with ANSI A14.3 unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.

### B. Steel Ladders:

1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch (12.7-by-64-mm) steel flat bars, with eased edges.
3. Rungs: 1-inch- (25-mm-) square steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
7. Galvanize ladders, including brackets and fasteners.

## 2.8 GUARD RAILS

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

- B. Assemble guard rails in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Cut, reinforce, drill, and tap as indicated to receive mounting hardware, screws, and similar items.
- F. Connections: Fabricate guard rails with welded connections unless otherwise indicated.
- G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- H. Brackets, Flanges, Fittings, and Anchors: Provide mounting brackets to interconnect railing members to existing hanger rods.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- I. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.
  - 1. Orient wire mesh with wires perpendicular and parallel to top rail.

## 2.9 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

## 2.10 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized.
  - 1. Shop prime with primers specified in Section 099123 "Interior Painting".
- C. Preparation for Shop Priming: Prepare surfaces to comply with [SSPC-SP 3, "Power Tool Cleaning."

## 2.11 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

### 3.2 INSTALLING FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

### 3.3 GUARD RAIL INSTALLATION

- A. Nonwelded Connections: Use mechanical joints for permanently connecting guard rail panels to existing hanger rods. Fully tighten and torque all bolted connections.

### 3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

## SECTION 057000

### ARCHITECTURAL METAL FABRICATIONS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cover plates at fire alarm pull stations.
- B. Related Sections:
  - 1. Section 055000 "Metal Fabrications" for non-decorative metal fabrications.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative metal.
  - 1. Include plans, elevations, component details, and attachments to other work.
  - 2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
- C. Samples for Verification: For each type of exposed finish required.
  - 1. Full-size Samples.
- D. Qualification Data: For qualified fabricator.
- E. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

##### 1.4 QUALITY CONTROL

- A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Fabricator of products.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- B. Deliver and store cast-metal products in wooden crates surrounded by sufficient packing material to ensure that products will not be cracked or otherwise damaged.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

## 1.7 COORDINATION

- A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

### 2.2 STAINLESS STEEL

- A. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304.

### 2.3 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
  - 1. Stainless-Steel Items: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
- C. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

## 2.4 FABRICATION, GENERAL

- A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.

## 2.5 FIRE ALARM PULL STATION COVER PLATES

- A. Fabricate units of stainless steel to comply with details indicated. Coordinate with requirements in Section 142100 "Electric Traction Elevators" to provide integrated, closely fitted assemblies.
  - 1. Fabricate faceplates from 1/8-inch- (3.2-mm-) thick sheet with edges beveled at a 45-degree angle for one-half thickness of metal.
  - 2. Laser of water jet cut plates to the profile shown on the drawings.
  - 3. Laser engrave graphics and text into face of plates.
  - 4. Paint reveals in graphics as indicated on the drawings.
  - 5. Existing pull station boxes:
    - a. Acquire existing cast aluminum pull station boxes from the .4 Electrical Contractor after removal.
    - b. Clean and paint boxes with a low gloss red alkyd enamel paint. Provide two colors via spray application.
  - 6. Provide cutouts in faceplates of units. Coordinate locations and sizes of cutouts so additional faceplate is not required.

## 2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## 2.7 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Directional Satin Finish: No. 4.



- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.
- C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- E. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
  - 1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.

### 3.3 INSTALLING FIRE ALARM PULL STATION COVER PLATES

- A. Coordinate installation of cover plates with installation of fire alarm system upgrade by the .4 Electrical Contractor. Secure units in place with faceplate overlapping surrounding wall finish and drawn into contact with surrounding wall finish at entire perimeter of faceplate.

### 3.4 CLEANING AND PROTECTION

- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

- B. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.
- C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057000

## SECTION 061053

### MISCELLANEOUS ROUGH CARPENTRY

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Framing with dimension lumber.
  - 2. Wood blocking and nailers.
  - 3. Plywood backing panels.

##### 1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
  - 2. NHLA: National Hardwood Lumber Association.
  - 3. NLGA: National Lumber Grades Authority.
  - 4. SPIB: The Southern Pine Inspection Bureau.
  - 5. WCLIB: West Coast Lumber Inspection Bureau.
  - 6. WWPA: Western Wood Products Association.

##### 1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
  - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Evaluation Reports: For the following, from ICC-ES:

1. Fire-retardant-treated wood.

## 1.5 QUALITY CONTROL

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent.

### 2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
  2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Application: Fire treat all miscellaneous carpentry unless otherwise indicated.

### 2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
  2. Nailers.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:
1. Hem-fir (north); NLGA.
  2. Mixed southern pine; SPIB.
  3. Spruce-pine-fir; NLGA.
  4. Hem-fir; WCLIB or WWPA.
  5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
  6. Western woods; WCLIB or WWPA.
  7. Northern species; NLGA.
  8. Eastern softwoods; NeLMA.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

### 2.4 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

## 2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacturer.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Metal Framing: ASTM C 1002 or ASTM C 954, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
  - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

## 2.6 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
  - 1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- C. Install plywood backing panels by fastening to studs or masonry walls; coordinate locations with utilities requiring backing panels.

- D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- E. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.

### 3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

### 3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

## SECTION 078413

### PENETRATION FIRESTOPPING

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For qualified Installer.
- C. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

##### 1.4 QUALITY CONTROL

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

##### 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.



- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

## 1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. A/D Fire Protection Systems Inc.
  - 2. Grace Construction Products.
  - 3. Hilti, Inc.
  - 4. Johns Manville.
  - 5. Nelson Firestop Products.
  - 6. 3M Fire Protection Products.
  - 7. Tremco, Inc.; Tremco Fire Protection Systems Group.
  - 8. USG Corporation.

### 2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  - 1. Fire-resistance-rated walls include fire-barrier walls and fire partitions.
  - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  - 1. Horizontal assemblies include floors.
  - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
  - 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

- D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - 1. Sealants: 250 g/L.
  - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
  - 3. Sealant Primers for Porous Substrates: 775 g/L.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
  - 1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-wool-fiber or rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - c. Fire-rated form board.
    - d. Fillers for sealants.
  - 2. Temporary forming materials.
  - 3. Substrate primers.
  - 4. Collars.
  - 5. Steel sleeves.

## 2.3 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Putties: Non-hardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- D. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- E. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- F. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- G. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

H. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and non-sag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of non-sag grade for both opening conditions.

## 2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
  2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
  3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Frog Tape: Use special no damaging masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

### 3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

## SECTION 079200

### JOINT SEALANTS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Silicone joint sealants.
  - 2. Latex joint sealants.
- B. Related Sections:
  - 1. Section 040140 "Maintenance of Stone Assemblies" for sealant used for stone joints.

##### 1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.
- D. Qualification Data: For qualified Installer.
- E. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- G. Warranties: Sample of special warranties.

#### 1.4 QUALITY CONTROL

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
  - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

#### 1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg. F (5 deg. C).
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

#### 1.6 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - 1. Architectural Sealants: 250 g/L.
  - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
  - 3. Sealant Primers for Porous Substrates: 775 g/L.

- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
  - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Colors of Exposed Joint Sealants: As selected by Professional's from manufacturer's full range.

## 2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Non-sag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 790.
    - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
    - c. Pecora Corporation; 301 NS.
    - d. Sika Corporation, Construction Products Division; SikaSil-C990.
    - e. Tremco Incorporated; Spectrem 1.

## 2.3 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Building Systems; Sonolac.
    - b. Bostik, Inc.; Chem-Calk 600.
    - c. Pecora Corporation; AC-20+.
    - d. Schnee-Morehead, Inc.; SM 8200.
    - e. Tremco Incorporated; Tremflex 834.

## 2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bi-cellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
  3. Remove laitance and form-release agents from concrete.
  4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:



- a. Metal.
  - b. Glass.
  - c. Porcelain enamel.
  - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
- 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Non-Sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
- 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.

### 3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces JS-1.
  - 1. Joint Locations:
    - a. Perimeter joints at frames of louvers.
  - 2. Silicone Joint Sealant: Single component, non-sag, neutral curing, Class 100/50.
  - 3. Joint-Sealant Color: As selected by Professional from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces JS-2.
  - 1. Joint Locations:
    - a. Perimeter joints between interior wall surfaces and frames of interior doors.
  - 2. Joint Sealant: Latex acrylic based.
  - 3. Joint-Sealant Color: As selected by Professional from manufacturer's full range of colors.

END OF SECTION 079200

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES				HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER	
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL					FINISH
					WIDTH	HEIGHT	THICK						
<b>STATE ARCHIVES OF PENNSYLVANIA - GROUND FLOOR</b>													
AG02-1	WEST COURTYARD AG-CY1	VESTIBULE AG02	EXISTING ALUMINUM	EXISTING	3'-6"	7'-8"	1-3/4"	EXISTING ALUMINUM/GLASS	EXISTING	2	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	AG02-1
AG02-2	CORRIDOR AG01	VESTIBULE AG02	EXISTING ALUMINUM	EXISTING	3'-8-1/2"	7'-8"	1-3/4"	EXISTING ALUMINUM/GLASS	EXISTING	2	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	AG02-2
AG15-1	EAST COURTYARD AG-CY2	RECORDS CENTER AG15	EXISTING ALUMINUM	EXISTING	3'-8-1/2"	7'-8"	1-3/4"	EXISTING ALUMINUM/GLASS	EXISTING	2	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	AG15-1
AG15-2	EAST COURTYARD AG-CY2	RECORDS CENTER AG15	EXISTING ALUMINUM	EXISTING	3'-8-1/2"	7'-8"	1-3/4"	EXISTING ALUMINUM/GLASS	EXISTING	2	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	AG15-2
AG24B-1	WEST COURTYARD AG-CY1	VESTIBULE AG24B	EXISTING ALUMINUM	EXISTING	(2) 2'-6"	7'-0"	1-3/4"	EXISTING ALUMINUM/GLASS	EXISTING	2	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE		AG24B-1
AG32-1	WEST COURTYARD AG-CY1	VESTIBULE AG32	EXISTING ALUMINUM	EXISTING	3'-8-1/2"	7'-8"	1-3/4"	EXISTING ALUMINUM/GLASS	EXISTING	2	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	AG32-1
AG32-2	CORRIDOR AG33	VESTIBULE AG32	EXISTING ALUMINUM	EXISTING	3'-8"	7'-8"	1-3/4"	EXISTING ALUMINUM/GLASS	EXISTING	2	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	AG32-2
<b>STATE MUSEUM OF PENNSYLVANIA - BASEMENT LEVEL</b>													
B017A	MECHANICAL SPACE B012	MECHANICAL ACCESS B017	HOLLOW METAL	PNT P1	(2) 4'-0"	9'-9"	1-3/4"	HOLLOW METAL	PNT P1	1	NEW FRAME AND DOOR FIELD VERIFY HEIGHT & WIDTH OF OPENING	B-5	B017A
SB04	MECHANICAL SPACE B012	PUBLIC STAIR 04 SB04 (MUSEUM CENTRAL STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-8"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	43	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	SB04
<b>STATE MUSEUM OF PENNSYLVANIA - GROUND FLOOR</b>													
G01	CORRIDOR G086A	CATALOGS G001	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G01
G03	CORRIDOR G86A	SECURITY OFFICE / BREAK ROOM G03	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G03
G03A-1	CORRIDOR G86A	SECURITY OFFICE G03A (ZACK CHADWICK)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G03A-1
G03A-2	SECURITY/BREAK G04	SECURITY OFFICE G03A (ZACK CHADWICK)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G03A-2
G03B-1	SECURITY/BREAK G04	SECURITY OFFICE G003B (RON LEE)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G03B-1
G03B-2	SECURITY OFFICE G03A	SECURITY OFFICE G003B (RON LEE)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G03B-2
G04A-1	CORRIDOR G86A	SECURITY OFFICE G04A (TONY BROWN)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G04A-1
G04A-2	SECURITY OFFICE / BREAK ROOM G03	SECURITY OFFICE G04A (TONY BROWN)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G04A-2
G04B	OFFICE G04A	STORAGE G04B	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G04B
G05	CORRIDOR G86A	JANITOR'S SUPPLIES G05	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G05
G06	CORRIDOR G86A	JANITOR'S SUPPLIES G06	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G06
G06A	JANITOR'S SUPPLIES G06	TELEPHONE G06A	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G06A
G07-1	CORRIDOR G86A	BUILDING SUPERINTENDENT G07 (ROGER CIECIERSKI)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G07-1
G07-2	PUBLICATIONS' STORAGE G13A	BUILDING SUPERINTENDENT G07 (ROGER CIECIERSKI)	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G07-2
G08	CORRIDOR G86A	JANITOR'S CLOSET G08	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G08

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES				HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER	
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL					FINISH
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - GROUND FLOOR (CONTINUED)</b>													
G10	CORRIDOR G79B	CARPENTRY SHOP G10	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G10
G10A	CARPENTRY SHOP G10	SHOP OFFICE G10A (LONNIE WEIMER)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G10A
G11-1	PROMENADE G145	WORK ROOM G11	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	8'-0"	EXISTING	EXISTING WOOD	EXISTING	28	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G11-1
G11-2	NORTH CORRIDOR G05B	WORK ROOM G11	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G11-2
G11A	CARPENTRY SHOP G11C	PAINT SPRAY ROOM G11A	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	8'-0"	EXISTING	EXISTING HOLLOW METAL	EXISTING	30	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G11A
G11C	CARPENTRY SHOP G10	CARPENTRY PAINT SHOP G11C	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	8'-0"	EXISTING	EXISTING HOLLOW METAL	EXISTING	40	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G11C
G11B-1	CORRIDOR G79B	CARPENTRY PAINT SHOP G11C	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	8'-0"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G11B-1
G11B-2	STORAGE G11B	CARPENTRY PAINT SHOP G11C	EXISTING HOLLOW METAL	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G11B-2
G12-1	CORRIDOR G79B	MARKER MAINTENANCE SHOP G12 (WORK ROOM)	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	8'-0"	EXISTING	EXISTING HOLLOW METAL	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G12-1
G12-2	PAINT SPRAY ROOM G11A	MARKER MAINTENANCE SHOP G12 (WORK ROOM)	EXISTING HOLLOW METAL	EXISTING	4'-0"	8'-0"	EXISTING	EXISTING HOLLOW METAL	EXISTING	31	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G12-2
G12-3	GENERAL STORAGE G15	MARKER MAINTENANCE SHOP G12 (WORK ROOM)	EXISTING HOLLOW METAL	EXISTING	3'-8"	7'-0"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G12-3
G13-1	CORRIDOR G45	PUBLICATIONS STORAGE G13B (EXHIBITS WORK AREA)	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	32	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G13-1
G13-2	CORRIDOR G79B	PUBLICATIONS STORAGE G13B (EXHIBITS WORK AREA)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G13-2
G13A-1	STORAGE G13C	PUBLICATIONS STORAGE G13B OFFICE - ALAN BYLER)	EXISTING ALUMINUM	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G13A-1
G13A-2	STORAGE G13C	PUBLICATIONS STORAGE G13B OFFICE - ALAN BYLER)	EXISTING ALUMINUM	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G13A-2
G14-1	CORRIDOR G79B	RECEIVING/SHIPPING G14	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G14-1
G14-2	VESTIBULE G76	RECEIVING/SHIPPING G14	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G14-2
G15	CORRIDOR G79B	GENERAL STORAGE G15	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	8'-0"	EXISTING	EXISTING HOLLOW METAL	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G15
G16	VESTIBULIE G76	STORAGE / G16 OFFICE (BRAD EANONE)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G16
G17	VESTIBULE G76	MAILING ROOM G17 (MUSEUM STORE / STORAGE)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	33	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G17
G18-1	VESTIBULE G76	COMMAND CENTER G18	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G18-1
G18-2	DOCUMENT RECEIVING G19	COMMAND CENTER G18	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G18-2
G18A	GARAGE G93	COMMAND CENTER VESTIBULE	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G18A
G18B	DOCUMENT RECEIVING G19	ELECTRICAL CLOSET G18B	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G18B

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - GROUND FLOOR (CONTINUED)</b>													
G19	RECORDS CENTER AG55 (LOCATED IN ARCHIVES)	DOCUMENT RECEIVING G019	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	8'-0"	EXISTING	EXISTING HOLLOW METAL	EXISTING	31	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G19
G20	AUDITORIUM G120	TICKET OFFICE G20	EXISTING WOOD	EXISTING	2'-6"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G20
G21-1	AUDITORIUM FOYER G098	BRIDE'S ROOM G21	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G21-1
G21-2	CLASSROOM G24	BRIDE'S ROOM G21	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G21-2
G22	CLASSROOM G24	OFFICE G22	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G22
G23	CORRIDOR G106	AUDITORIUM COAT ROOM G23	EXISTING WOOD	EXISTING	(2) 2'-4"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	34	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G23
G24	CORRIDLR G106	CLASSROOM G24	EXISTING WOOD	EXISTING	(2) 2'-8"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	35	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G24
G26	ENTRY G101	JANITOR'S CLOSET	EXISTING WOOD	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G26
G28-1	CORRIDOR G106	OFFICE G28	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G28-1
G28-2	LIBRARY WORKROOM G27A	OFFICE G28	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G28-2
G28A	STAIR G08	FIRST FLOOR KITCHENETTE G28A	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G28A
G29-1	CORRIDOR G106	GREEN ROOM G29	EXISTING WOOD	EXISTING	(2) 2'-8"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	35	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G29-1
G29-2	STAIR 11 SG11	GREEN ROOM G29	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	36	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G29-2
G30	CORRIDOR G106	LIBRARY WORK ROOM G30	EXISTING WOOD	EXISTING	(2) 2'-8"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	35	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G30
G31-1	CORRIDOR G106	STORAGE G31	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G31-1
G31-2	GREEN ROOM G29	STORAGE G31	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G31-2
G32A	STAGE G121	WOMEN'S DRESSING ROOM G32A	EXISTING WOOD	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G32A
G33	STAGE G121	STAGE STORAGE	EXISTING WOOD	EXISTING	(2) 3'-0"	8'-0"	EXISTING	EXISTING WOOD	EXISTING	35	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G33
G34A	STAGE G121	MEN'S DRESSING ROOM G34A	EXISTING WOOD	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G34A
G35	STAIR 09 SG09	AUDITORIUM CONFERENCE ROOM G35	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G35
G36-1	AUDITORIUM CONFERENCE ROOM G35	STAIR 07 SG07	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G36-1
G36-2	STAIR 07 SG07	PROJECTION ROOM G36	EXISTING WOOD	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G36-2
G36A	STAIR 07 SG07	PROJECTION STORAGE G36A	EXISTING WOOD	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G36A

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES				HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER	
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL					FINISH
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - GROUND FLOOR (CONTINUED)</b>													
G37-1	PROMENADE G145	SUSQUEHANNA ROOM G37	EXISTING ALUMINUM	EXISTING	3'-0"	8'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	39	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G37-1
G37-2	PROMENADE G145	SUSQUEHANNA ROOM G37	EXISTING ALUMINUM	EXISTING	(3) 5'-5"	11'-6"	EXISTING	EXISTING ALUMINUM	EXISTING	28	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G37-2
G37-3	SOUTH CORRIDOR G05C	SUSQUEHANNA ROOM G37	EXISTING WOOD	EXISTING	3'-0"	8'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G37-3
G37-4	GALLERY G39 (CURIOSITY CONNECTION)	SUSQUEHANNA ROOM G37	EXISTING WOOD	EXISTING	(2) 4'-0"	10'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G37-4
G37A	SUSQUEHANNA ROOM G37	IT CLOSET	EXISTING WOOD	EXISTING	3'-0"	8'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G37A
G38	PROMENADE G145	WORK ROOM G38	EXISTING WOOD	EXISTING	(2) 2-9 1/2"	7'-4 1/2"	EXISTING	EXISTING WOOD	EXISTING	15	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G38
G39-1	LOBBY G05A	GALLERY G39 (CURIOSITY CONNECTION)	EXISTING WOOD	EXISTING	(2) 3'-0"	10'-0"	EXISTING	EXISTING WOOD	EXISTING	39	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G39-1
G39-2	SOUTH CORRIDOR G05C	GALLERY G39 (CURIOSITY CONNECTION)	EXISTING WOOD	EXISTING	3'-0"	8'-0"	EXISTING	EXISTING WOOD	EXISTING	11	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G39-2
G39A	GALLERY G39 (CURIOSITY CONNECTION)	WASHROOM G39A (CURIOSITY CONNECTION)	EXISTING WOOD	EXISTING	3'-0"	8'-0"	EXISTING	EXISTING WOOD	EXISTING	17	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G39A
G40	LOBBY G05A	STORAGE G40	EXISTING WOOD	EXISTING	3'-0"	8'-0"	EXISTING	EXISTING WOOD	EXISTING	28	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G40
G40A	LOBBY G05A	FIRE COMMAND CENTER G40A	EXISTING WOOD	EXISTING	3'-0"	8'-0"	EXISTING	EXISTING WOOD	EXISTING	28	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G40A
G41	NORTH CORRIDOR G05B	COATS / LOCKER ROOM G41	EXISTING WOOD	EXISTING	3'-0"	8'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G41
G42-1	LOBBY G05A	MUSEUM GIFT SHOP G42	EXISTING WOOD	EXISTING	(2) 3'-0"	10'-0"	EXISTING	EXISTING WOOD	EXISTING	39	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G42-1
G42-2	GALLERY	MUSEUM GIFT SHOP G42	EXISTING WOOD	EXISTING	2'-6"	6'-5"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G42-2
G-43-1	MUSEUM GIFT SHOP G42	MUSEUM GIFT SHOP G43	EXISTING ALUMINUM	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	28	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G-43-1
G43-2	ALLEGHENY ROOM G44	MUSEUM GIFT SHOP G43	EXISTING ALUMINUM	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	28	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G43-2
G044	PROMENADE G145	ALLEGHENY ROOM G44	EXISTING ALUMINUM	EXISTING	(2) 3'-0"	8'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	28	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G044
G45	PROMENADE G145	BABY CHANGING / FIRST AID G45	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	17	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G45
G45A-1	PROMENADE G145	FAMILY WASHROOM G45A	EXISTING WOOD	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	17	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G45A-1
G45A-2	BABY CHANGING G45	FAMILY WASHROOM G45A	EXISTING WOOD	EXISTING	2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	17	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G45A-2
G46A	WOMEN'S WASHROOM G46	CHASE G46A (WOMEN'S WASHROOM)	EXISTING WOOD	EXISTING	1'-8"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G46A
G47A	MEN'S WASHROOM G47	CHASE G47A (MEN'S WASHROOM)	EXISTING WOOD	EXISTING	1'-8"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G47A
G48	CORRIDOR G86C	CAFÉ	EXISTING WOOD	EXISTING	(2) 3'-0"	7'-5"		EXISTING WOOD	EXISTING	16	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G48
G86C	CORRIDOR G86C	CORRIDOR G86	EXISTING WOOD	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	28	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	G86C

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - GROUND FLOOR (CONTINUED)</b>													
G120-1 (AE-1)	AUDITORIUM FOYER G098	AUDITORIUM G120	EXISTING WOOD	EXISTING	(2) 2'-6"	7'-0"	1-3/4"	EXISTING WOOD	EXISTING	9	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-9	G120-1 (AE-1)
G120-2 (AE-2)	AUDITORIUM FOYER G098	AUDITORIUM G120	EXISTING WOOD	EXISTING	(2) 2'-6"	7'-0"	1-3/4"	EXISTING WOOD	EXISTING	9	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-9	G120-2 (AE-2)
G120-3 (AE-3)	AUDITORIUM FOYER G098	AUDITORIUM G120	EXISTING WOOD	EXISTING	(2) 2'-6"	7'-0"	1-3/4"	EXISTING WOOD	EXISTING	9	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-9	G120-3 (AE-3)
G121	GARAGE G93	STAGE G121	EXISTING WOOD	EXISTING	(2) 2'-6"	7'-0 3/4"	1-3/4"	EXISTING WOOD	EXISTING	38	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-9	G121
3SE-1	LOGGIA G00A	THIRD STREET ENTRANCE (EXTERIOR PAIR OF DOORS)	EXISTING WOOD	EXISTING	(2) 3'-0"	10'-0"	EXISTING	EXISTING STAINLESS-STEEL AND GLASS	EXISTING	28	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	3SE-1
3SE-2	LOGGIA G00A	THIRD STREET ENTRANCE (EXTERIOR PAIR OF DOORS)	EXISTING WOOD	EXISTING	(2) 3'-0"	10'-0"	EXISTING	EXISTING STAINLESS-STEEL AND GLASS	EXISTING	29	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	3SE-2
AR-1	LOADING PLATFORM G081	DOCUMENT RECEIVING G019	EXISTING WOOD	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	AR-1
ER-1	WORK ROOM G31A	SOUTH ELECTRICAL ROOM G141	EXISTING WOOD	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	ER-1
ER-2	WORK ROOM G11	NORTH ELECTRICAL ROOM G137	EXISTING WOOD	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	ER-2
FE-1	PASSAGE G123	STAGE G121	EXISTING WOOD	EXISTING	(2) 2'-6"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	38	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	FE-1
FE-2	PASSAGE G123	STAGE G121	EXISTING WOOD	EXISTING	3'-0"	8'-0"	EXISTING	EXISTING HOLLOW METAL	EXISTING	31	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	FE-2
FSE-1	LOGGIA G00A	FORSTER STREET ENTRANCE (EXTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	EXISTING	41	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	FSE-1
FSE-2	LOGGIA G00A	FORSTER STREET ENTRANCE (INTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	EXISTING	41	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	FSE-2
FSE-3	LOGGIA G00A	FORSTER STREET ENTRANCE (EXTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	EXISTING	41	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	FSE-3
FSE-4	LOGGIA G00A	FORSTER STREET ENTRANCE (EXTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	EXISTING	40	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	FSE-4
FSE-5	LOGGIA G00A	FORSTER STREET ENTRANCE (EXTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	EXISTING	40	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	FSE-5
FSE-6	LOGGIA G00A	FORSTER STREET ENTRANCE (EXTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	EXISTING	40	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	FSE-6
GV	CORRIDOR AG45 (IN ARCHIVES BUILDING)	VAULT G01A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NO WORK AT THIS DOOR / SHOWN FOR REFERENCE ONLY	N/A	GV
NSE-1	LOGGIA G00A	NORTH STREET ENTRANCE (EXTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	EXISTING	42	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	NSE-1
NSE-2	LOGGIA G00A	NORTH STREET ENTRANCE (EXTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	EXISTING	42	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	NSE-1
NSE-3	LOGGIA G00A	NORTH STREET ENTRANCE (EXTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	EXISTING	42	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	NSE-1

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - GROUND FLOOR (CONTINUED)</b>													
NSE-4	NSE-5	LOGGIA G00A	NORTH STREET ENTRANCE (INTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	40	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	NSE-4
NSE-5	LOGGIA G00A	NORTH STREET ENTRANCE (INTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	EXISTING	40	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	NSE-5
NSE-6	LOGGIA G00A	NORTH STREET ENTRANCE (INTERIOR SET OF DOORS)	EXISTING ALUMINUM	EXISTING	(2) 2'-11"	7'-6-1/8"	EXISTING	EXISTING ALUMINUM AND GLASS	EXISTING	40	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	NSE-6
SG03-1	EXTERIOR PORTICO	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING ALUMINUM	EXISTING	(2) 2'-6"	7'-7"	1-3/4"	ALUMINUM	CLEAR ANODIZED	10	PROVIDE NEW DOORS; REFER TO SPEC SECTION 084117 REFER TO SPECIFICATION 087111 FOR HARDWARE	B-11	SG03-1
SG03-2	EXTERIOR PORTICO	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING ALUMINUM	EXISTING	(2) 2'-6"	7'-7"	1-3/4"	ALUMINUM	CLEAR ANODIZED	10	PROVIDE NEW DOORS; REFER TO SPEC SECTION 084117 REFER TO SPECIFICATION 087111 FOR HARDWARE	B-11	SG03-2
SG03-3	VESTIBULE G144	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING ALUMINUM	EXISTING	(2) 2'-6"	7'-7"	1-3/4"	ALUMINUM	CLEAR ANODIZED	7	PROVIDE NEW DOORS; REFER TO SPEC SECTION 084117 REFER TO SPECIFICATION 087111 FOR HARDWARE	B-11	SG03-3
SG04	PROMENADE G145	PUBLIC STAIR 04 (MUSEUM CENTRAL STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-8 3/4"	7'-4 5/8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	43	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	SG04
SG06-1	EXTERIOR PORTICO	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING ALUMINUM	EXISTING	(2) 2'-6"	7'-7"	1-3/4"	EXISTING ALUMINUM	EXISTING	6	PROVIDE NEW DOORS; REFER TO SPEC SECTION 084117 REFER TO SPECIFICATION 087111 FOR HARDWARE	B-11	SG06-1
SG06-2	EXTERIOR PORTICO	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING ALUMINUM	EXISTING	(2) 2'-6"	7'-7"	1-3/4"	EXISTING ALUMINUM	EXISTING	6	PROVIDE NEW DOORS; REFER TO SPEC SECTION 084117 REFER TO SPECIFICATION 087111 FOR HARDWARE	B-11	SG06-2
SG06-3	VESTIBULE G146	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING ALUMINUM	EXISTING	(2) 2'-6"	7'-7"	1-3/4"	EXISTING ALUMINUM	EXISTING	7	PROVIDE NEW DOORS; REFER TO SPEC SECTION 084117 REFER TO SPECIFICATION 087111 FOR HARDWARE	B-11	SG06-3
SG12	PASSAGE G123	STAIR 12 SG12	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	39	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	SG12
SG-13 (MT)	PASSAGE G123	MAINTENANCE TUNNEL / STAIR 13 SG13	EXISTING WOOD	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	SG-13 (MT)
SPC-1	STAIR 11 SF11	AUDITORIUM G120 (STAGE PIPE CHASE)	EXISTING WOOD	EXISTING	2'-6"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	SPC-1
SPC-2	PASSAGE G123	AUDITORIUM G120 (STAGE PIPE CHASE)	EXISTING WOOD	EXISTING	2'-6"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	SPC-2



## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES				HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER	
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL					FINISH
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - FIRST FLOOR</b>													
100	LOBBY 115	SALES 100 (OLD MUSEUM STORE)	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	7'-0"	EXISTING	EXISTING ALUMUNUM AND GLASS	EXISTING	28	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	100
100A	SALES 100 (OLD MUSEUM STORE)	STROAGE 124 (OLD BUILDING MANAGER)	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	15	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	100A
106	ENTRY 109	KITCHEN 106	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	7'-7"	EXISTING	EXISTING WOOD	EXISTING	21	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	106
109	VILLAGE SQUARE EXHIBIT 103 (NORTH GALLERIES)	ENTRY 109	EXISTING HOLLOW METAL	EXISTING	(3) 3'-0"	7'-3"	EXISTING	EXISTING HOLLOW METAL	EXISTING	27	SET OF THREE DOORS ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	109
115-1	EXTERIOR PORTICO	ENTRY 116	EXISTING ALUMINUM	EXISTING	3'-0 7/16"	9'-11"	1-3/4"	EXISTING ALUMINUM	EXISTING	5	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	115-1
115-2	EXTERIOR PORTICO	ENTRY 116	EXISTING ALUMINUM	EXISTING	3'-0 7/16"	9'-11"	1-3/4"	EXISTING ALUMINUM	EXISTING	5	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	115-2
115-3	EXTERIOR PORTICO	ENTRY 116	EXISTING ALUMINUM	EXISTING	3'-0 7/16"	9'-11"	1-3/4"	EXISTING ALUMINUM	EXISTING	5	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	115-3
115-4	EXTERIOR PORTICO	ENTRY 116	EXISTING ALUMINUM	EXISTING	3'-0 7/16"	9'-11"	1-3/4"	EXISTING ALUMINUM	EXISTING	5	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	115-4
115-5	EXTERIOR PORTICO	ENTRY 116	EXISTING ALUMINUM	EXISTING	3'-0 7/16"	9'-11"	1-3/4"	EXISTING ALUMINUM	EXISTING	5	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	115-5
116-1	ENTRY 116	LOBBY 115	EXISTING ALUMINUM	EXISTING	3'-0 7/16"	9'-11"	1-3/4"	EXISTING ALUMINUM	EXISTING	13	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	116-1
116-2	ENTRY 116	LOBBY 115	EXISTING ALUMINUM	EXISTING	3'-0 7/16"	9'-11"	1-3/4"	EXISTING ALUMINUM	EXISTING	13	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	116-2
116-3	ENTRY 116	LOBBY 115	EXISTING ALUMINUM	EXISTING	3'-0 7/16"	9'-11"	1-3/4"	EXISTING ALUMINUM	EXISTING	13	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	116-3
116-4	ENTRY 116	LOBBY 115	EXISTING ALUMINUM	EXISTING	3'-0 7/16"	9'-11"	1-3/4"	EXISTING ALUMINUM	EXISTING	13	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	116-4
116-5	ENTRY 116	LOBBY 115	EXISTING ALUMINUM	EXISTING	3'-0 7/16"	9'-11"	1-3/4"	EXISTING ALUMINUM	EXISTING	13	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	116-5
122	PASSAGE 132 (SOUTH GALLERIES)	ENTRY 122	EXISTING HOLLOW METAL	EXISTING	(3) 3'-0"	7'-3"	EXISTING	EXISTING HOLLOW METAL		27	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	122
141	MEN'S WASHROOM 118	ELECTRICAL ROOM 141	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	141
1-C-1	MEN'S WASHROOM 118	JANITOR'S CLOSET 119	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"				14	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	1-C-1
1-CG-1	MEMOROIAL HALL 114 (WEST / SECURE SIDE)	ENTRY 109	EXISTING HOLLOW METAL	EXISTING	2'-6"	9'-3"	EXISTING	EXISTING ALUMINUM	EXISTING	28	EXISTING CHARTER GATE ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	1-CG-1
1-CG-2	MEMOROIAL HALL 114 (EAST / LOBBY SIDE)	MEMOROIAL HALL 114 (WEST / SECURE SIDE)	EXISTING HOLLOW METAL	EXISTING	2'-6"	9'-3"	EXISTING	EXISTING ALUMINUM	EXISTING	28	EXISTING CHARTER GATE ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	1-CG-2
1-CG-3	MEMOROIAL HALL 114 (EAST / LOBBY SIDE)	MEMOROIAL HALL 114 (WEST / SECURE SIDE)	EXISTING HOLLOW METAL	EXISTING	2'-6"	9'-3"	EXISTING	EXISTING ALUMINUM	EXISTING	28	EXISTING CHARTER GATE ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	1-CG-3
1-CG-4	MEMOROIAL HALL 114 (WEST / SECURE SIDE)	ENTRY 122	EXISTING HOLLOW METAL	EXISTING	2'-6"	9'-3"	EXISTING	EXISTING ALUMINUM	EXISTING	28	EXISTING CHARTER GATE ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	1-CG-4
1-CR-1	LOBBY 115	COATS 110	EXISTING HOLLOW METAL	EXISTING	3'-0"	9'-3"	EXISTING	EXISTING WOOD	EXISTING	24	ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	1-CR-1
1-CR-2	LOBBY 115	COATS 110	EXISTING HOLLOW METAL	EXISTING	3'-0"	9'-3"	EXISTING	EXISTING WOOD	EXISTING	24	ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	1-CR-2
1-GN	LOBBY 115	VILLAGE SQUARE EXHIBIT 105 (NORTH GALLERIES)	EXISTING HOLLOW METAL	EXISTING	(2) 4'-0"	9'-3"	EXISTING	EXISTING HOLLOW METAL w/WOOD FACE	EXISTING	21	MAIN ENTRANCE INTO NORTH GALLERIES ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	1-GN
1-GS	LOBBY 115	DEMONSTRATION EXHIBITS 127& 129	EXISTING HOLLOW METAL	EXISTING	(2) 4'-0"	9'-0"	EXISTING	EXISTING HOLLOW METAL w/WOOD FACE	EXISTING	11	MAIN ENTRANCE INTO SOUTH GALLERIES ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	1-GS

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - FIRST FLOOR (CONTINUED)</b>													
105	WORK ROOM 104	NORTH ELECTRICAL ROOM 105	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	105
115-1	ENTRY 116	LOBBY 225	EXISTING ALUMINUM	EXISTING	3'-0"	10'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	5	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	115-1
115-2	ENTRY 116	LOBBY 225	EXISTING ALUMINUM	EXISTING	3'-0"	10'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	5	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	115-2
115-3	ENTRY 116	LOBBY 225	EXISTING ALUMINUM	EXISTING	3'-0"	10'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	5	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	115-3
115-4	ENTRY 116	LOBBY 225	EXISTING ALUMINUM	EXISTING	3'-0"	10'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	5	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	115-4
115-5	ENTRY 116	LOBBY 225	EXISTING ALUMINUM	EXISTING	3'-0"	10'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	5	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	115-5
116-1	MUSEUM PLAZA (OUTDOORS)	ENTRY 116	EXISTING ALUMINUM	EXISTING	3'-0"	10'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	13	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	116-1
116-2	MUSEUM PLAZA (OUTDOORS)	ENTRY 116	EXISTING ALUMINUM	EXISTING	3'-0"	10'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	13	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	116-2
116-3	MUSEUM PLAZA (OUTDOORS)	ENTRY 116	EXISTING ALUMINUM	EXISTING	3'-0"	10'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	13	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	116-3
116-4	MUSEUM PLAZA (OUTDOORS)	ENTRY 116	EXISTING ALUMINUM	EXISTING	3'-0"	10'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	13	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	116-4
116-5	MUSEUM PLAZA (OUTDOORS)	ENTRY 116	EXISTING ALUMINUM	EXISTING	3'-0"	10'-0"	EXISTING	EXISTING ALUMINUM	EXISTING	13	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	116-5
S103-1	VILLAGE SQUARE EXHIBIT 103	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	S103-1
S103-2	VILLAGE SQUARE EXHIBIT 103	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	S103-2
S104-1	ENTRY 122	PUBLIC STAIR 04 (MUSEUM CENTRAL STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	7'-6"	1-3/4"	EXISTING HOLLOW METAL w/WOOD FACE	EXISTING	43	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	S104-1

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - SECOND FLOOR</b>													
S106-1	PASSAGE 132	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	S106-1
S106-2	PASSAGE 132	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-11	S106-2
201-1	WORK ROOM 201	JANITOR'S CLOSET 226	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	201-1
201-2	FORT HUNTER EXHIBIT 227 (NORTH GALLERY)	WORK ROOM 201	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	201-2
202	EXHIBIT 217	WORK ROOM 202 (STORAGE & CUSTODIAL)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	202
203-1	EXHIBIT 208	JANITOR'S CLOSET 203	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	203-1
203-2	JANITOR'S CLOSET 203	JANITOR'S STORAGE 211	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	203-2
204	EXHIBIT 208 (EMPTY SOUTH GALLERY)	CONFERENCE 204	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	204
219	WORK ROOM 202 (STORAGE & CUSTODIAL)	SOUTH ELECTRICAL ROOM 219	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	219
222	WORK ROOM 201	NORTH ELECTRICAL ROOM 222	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	222
2-G1	FORT HUNTER EXHIBIT 227 (NORTH GALLERY)	CURRENT FT HUNTER	EXISTING HOLLOW METAL	EXISTING	3'-0"	7'-3"	EXISTING	EXISTING HOLLOW METAL	EXISTING	27	SET OF THREE DOORS MAIN ENTRANCE INTO NORTH GALLERIES ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	2-G1
2-G2	EXHIBIT 208 (EMPTY SOUTH GALLERY)	ENTRY 213	EXISTING HOLLOW METAL	EXISTING	3'-0"	7'-3"	EXISTING	EXISTING HOLLOW METAL	EXISTING	27	SET OF THREE DOORS MAIN ENTRANCE INTO SOUTH GALLERIES ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	2-G2
S203-1	NORTH CORRIDOR	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S203-1
S203-2	NORTH CORRIDOR	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S203-2
S204	ENTRY 213	PUBLIC STAIR 04 (MUSEUM CENTRAL STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	7'-6"	1-3/4"	EXISTING HOLLOW METAL w/WOOD FACE	EXISTING	43	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S204
S206-1	EXHIBIT 208	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S206-1
S206-2	EXHIBIT 208	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S206-2

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - THIRD FLOOR</b>													
301-1	DIORAMA 31A	WORK ROOM 301 (STORAGE)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD		21	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	301-1
301-2	DIORAMA 332 (EMPLOYEE ACCESS SIDE)	WORK ROOM 301 (STORAGE)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	21	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	301-2
301-3	JANITOR'S CLOSET 337	WORK ROOM 301 (STORAGE)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	301-3
302-1	EXHIBIT 321 (SOUTH GALLERY AREA)	WORK ROM 302 (STORAGE)	EXISTING HOLLOW METAL	EXISTING	2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	21	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	302-1
302-2	DIORAMA 332 (EMPLOYEE ACCESS SIDE)	WORK ROM 302 (STORAGE)	EXISTING HOLLOW METAL	EXISTING	2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	21	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	302-2
303-1	VESTIBULE 317	JANITOR'S CLOSET 303	EXISTING HOLLOW METAL	EXISTING	3'-4"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	303-1
303-2	STORAGE 319	JANITOR'S CLOSET 303	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	303-2
304	ENTRY 303A	WORK ROOM 304	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	304
308-1	BALCONY 311	VESTIBULE 308	EXISTING HOLLOW METAL	EXISTING	(2) 3'-1 3/4"	7'-7"	2-5/8"	EXISTING WOOD	EXISTING	27	2" DOOR + 5/8" PLYWOOD FACE ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	308-1
308-2	BALCONY 311	VESTIBULE 308	EXISTING HOLLOW METAL	EXISTING	3'-1 3/4"	7'-7"	2-5/8"	EXISTING WOOD	EXISTING	27	2" DOOR + 5/8" PLYWOOD FACE ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	308-2
312-1	BALCONY 311	LOBBY 312	EXISTING HOLLOW METAL	EXISTING	4'-0"	7'-7"	EXISTING	EXISTING WOOD	EXISTING	14	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	312-1
312-2	ENTRY 309	LOBBY 312	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	312-2
313	LOBBY 312	OFFICE 313	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	DOOR NOT INSTALLED WITHIN FRAME ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	313
314-1	PLANETARIUM LOBBY 315	PLANETARIUM 314	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	1-3/4"	EXISTING WOOD	EXISTING	11	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-9	314-1
314-2	LOBBY 312	PLANETARIUM 314	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	1-3/4"	EXISTING WOOD	EXISTING	11	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-9	314-2
315-1	BALCONY 311	PLANETARIUM LOBBY 315	EXISTING HOLLOW METAL	EXISTING	4'-0"	7'-7"	EXISTING	EXISTING WOOD	EXISTING	12	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	315-1
315-2	ENTRY 316	PLANETARIUM LOBBY 315	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	12	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	315-2
321-1	BALCONY 311	EXHIBIT 321	EXISTING HOLLOW METAL	EXISTING	(2) 3'-1 3/4"	7'-7"	2-5/8"	EXISTING WOOD	EXISTING	27	2" DOOR + 5/8" PLYWOOD FACE ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	321-1
321-2	BALCONY 311	EXHIBIT 321	EXISTING HOLLOW METAL	EXISTING	3'-1 3/4"	7'-7"	2-5/8"	EXISTING WOOD	EXISTING	27	2" DOOR + 5/8" PLYWOOD FACE ADD AND/OR ADJUST EXISTING DOOR & HARDWARE PER SPECIFICATIONS SECTION 087111	B-3	321-2
324B	WORK ROOM 302	STORAGE 324B	EXISTING HOLLOW METAL	EXISTING	3'-0"	7'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	324B
329	WORK ROOM 302	SOUTH ELECTRICAL ROOM 329	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	329
333	WORK ROOM 301	NORTH ELECTRICAL ROOM 331	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	333

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - THIRD FLOOR (CONTINUED)</b>													
S301-1	EXHIBIT 302	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S301-1
S301-2	EXHIBIT 302	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S301-2
S304	REST AREA 324	PUBLIC STAIR 04 (MUSEUM CENTRAL STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	43	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S304
S306-1	EXHIBIT 321 (SOUTH GALLERY AREA)	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S306-1
S306-2	EXHIBIT 321 (SOUTH GALLERY AREA)	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S306-2
<b>STATE MUSEUM OF PENNSYLVANIA - FOURTH FLOOR</b>													
400-1	RECEPTION 400C	OFFICE 400	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	400-1
400-2	COATS 420B	OFFICE 400	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	20	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	400-2
400C	CENTRAL CORRIDOR 433	RECEPTION 400C	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	21	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	400C
401-1	NORTHEAST CORRIDOR 427	CDL STORAGE 401	EXISTING HOLLOW METAL	EXISTING	(2) 4'-0"	10'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	401-1
401-2	SOUTHEAST CORRIDOR 455	CDL STORAGE 401	EXISTING HOLLOW METAL	EXISTING	4'-0"	10'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	401-2
402-1	NORTHEAST CORRIDOR 427	OFFICE 402	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	402-1
402-2	CDL STORAGE 401	OFFICE 402	EXISTING HOLLOW METAL	EXISTING	N/A	N/A	N/A	N/A	EXISTING	N/A	EXISTING DOOR & WINDOWS ARE INFILLED NO WORK AT THIS DOOR / SHOWN FOR REFERENCE ONLY	N/A	402-2
402A-1	CDL STORAGE 401	MILITARY STORAGE 402A (FLAG ROOM)	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	402A-1
402A-2	CDL STORAGE 401	MILITARY STORAGE 402A (FLAG ROOM)	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	402A-2
403-1	NORTHEAST CORRIDOR 427	OFFICE 403 (BOB'S)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	403-1
403-2	OFFICE 402	OFFICE 403 (BOB'S)	EXISTING HOLLOW METAL	EXISTING	2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	403-2
404	NORTHEAST CORRIDOR 427	CUSTODIAL 404	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	404
405	NORTH CORRIDOR 435	STORAGE 405	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	405
406-1	NORTH CORRIDOR 435	STORAGE 406	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	406-1
406-2	OFFICE 403	STORAGE 406	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	406-2
407	NORTH CORRIDOR 435	FINE ARTS 407	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	10'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	407
407A	FINE ARTS 407	WORK ROOM 407A	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	407A
407B	WORK ROOM 407A	PICTURE FRAMES 407B	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	407B

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - FOURTH FLOOR (CONTINUED)</b>													
408-1	NORTH CORRIDOR 435	OFFICE 408	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	408-1
408-2	FINE ARTS 407	OFFICE 408	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	408-2
408-3	WORK ROOM 407A	OFFICE 408	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	20	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	408-3
409	NORTHWEST CORRIDOR 436	NORTH ELECTRICAL 409	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	409
410	NORTHWEST CORRIDOR 436	STORAGE 410	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	410
411	NORTHWEST CORRIDOR 436	FA/CDL STORAGE	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	10'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	411
414	WEST CORRIDOR 439	MILITARY & INDUSTRIAL STORAGE 414	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	10'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	414
415	MILITARY & INDUSTRIAL STORAGE 414	GUN VAULT 415	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	8	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	415
416	SOUTHWEST CORRIDOR 442	INDUSTRIAL 416	EXISTING HOLLOW METAL	EXISTING	(2) 4'-0"	10'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	416
419	SOUTHWEST CORRIDOR 442	SOUTH ELECTRICAL 419	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	419
423	SOUTH CORRIDOR 451	CDL STORAGE 423	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	10'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	423
425	SOUTHEAST CORRIDOR 455	POLITICAL 425	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	10'-0"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	425
414A	MILITARY & INDUSTRIAL STORAGE 414	LABORATORY 414A	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	414A
417-1	INDUSTRIAL 416	OFFICE 417	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	417-1
417-2	OFFICE 418	OFFICE 417	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	417-2
418-1	INDUSTRIAL 416	OFFICE 418	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	418-1
418-2	SOUTHWEST CORRIDOR 442	OFFICE 418	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	418-2
420-1	SOUTHWEST CORRIDOR 442	OFFICE 420	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	420-1
420-1	SOUTHWEST CORRIDOR 442	OFFICE 420	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	420-1
420-2	COATS 420B	OFFICE 420	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	20	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	420-2
421-1	SOUTHWEST CORRIDOR 442	OFFICE 421	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	421-1
421-2	CDL STORAGE 423	OFFICE 422	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	20	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	421-2
422-1	SOUTH CORRIDOR 451	OFFICE 422	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	422-1
422-1	CDL STORAGE 423	OFFICE 422	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	422-1

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - FOURTH FLOOR (CONTINUED)</b>													
424-1	SOUTHEAST CORRIDOR 455	OFFICE 424	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	424-1
424-2	POLITICAL 425	OFFICE 424	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	424-2
425A	POLITICAL 425	WORKROOM 425A	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	425A
426-1	OFFICE 424	OFFICE 426	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	426-1
426-2	POLITICAL 425	OFFICE 426	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	426-2
428-1	CENTRAL CORRIDOR 433	POP CULTURE 428	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	3	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	428-1
428-2	CENTRAL CORRIDOR 433	POP CULTURE 428	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	3	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	428-2
4-PM	CDL STORAGE 401	PLANETARIUM MEZZANINE	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	4-PM
S403A	NORTH CORRIDOR 435	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S403A
S403B-1	NORTH CORRIDOR 435	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S403B-1
<b>S403B-2X</b>	<b>STAIR 403A</b>	<b>STAIR 03 (MUSEUM NORTH STAIR)</b>	<b>EXISTING HOLLOW METAL</b>	<b>EXISTING</b>	<b>(2) 2'-6"</b>	<b>6'-8"</b>	<b>1-3/4"</b>	<b>EXISTING HOLLOW METAL</b>	<b>EXISTING</b>	<b>26</b>	<b>REMOVE EXISTING DOOR(S) AND HARDWARE TURN DOOR(S) &amp; HARDWARE OVER TO USING AGENCY EXISTING DOOR FRAME TO REMAIN</b>	<b>B-6</b>	<b>S403B-2X</b>
S404	CENTRAL CORRIDOR 433	PUBLIC STAIR 04 (MUSEUM CENTRAL STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	43	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S404
S406A	SOUTH CORRIDOR 451	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S406A
S406B	SOUTH CORRIDOR 451	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S406B
<b>STATE MUSEUM OF PENNSYLVANIA - FIFTH FLOOR</b>													
500-1	NORTH CORRIDOR 550	STORAGE 500	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	500-1
501-1	NORTH CORRIDOR 550	OFFICE 501 (JENNIFER STAUB)	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	501-1
501-2	NORTH CORRIDOR 550	OFFICE 501 (JENNIFER STAUB)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	501-2
<b>502X</b>	<b>PLENUM502</b>	<b>CLOSET</b>	<b>EXISTING HOLLOW METAL</b>	<b>EXISTING</b>	<b>3'-0"</b>	<b>6'-8"</b>	<b>EXISTING</b>	<b>EXISTING WOOD</b>	<b>EXISTING</b>	<b>N/A</b>	<b>REMOVE EXISTING DOOR AND FRAME</b>	<b>N/A</b>	<b>502X</b>
502-1	NORTH CORRIDOR 550	OFFICE 502	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	502-1
503	NORTH CORRIDOR 550	OFFIC 503 (ANDREA LOWERY)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	11	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	503
504-1	NORTH CORRIDOR 550	OFFICE 504 (RUSTY BAKER)	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	504-1
504-2	OFFICE 506	OFFICE 504 (RUSTY BAKER)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	504-2

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - FIFTH FLOOR (CONTINUED)</b>													
506-1	NORTH CORRIDOR 550	OFFICE 506	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	506-1
506-2	OFFICE 508 (CHERIE TRIMBLE)	OFFICE 506	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	506-2
507	NORTH CORRIDOR 550	OFFICE 507 (HOWARD POLLMAN)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	507
508-1	NORTH CORRIDOR 550	OFFICE 508 (CHERIE TRIMBLE)	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	508-1
508-2	OFFICE 512 (PARRISH BARNETT)	OFFICE 508 (CHERIE TRIMBLE)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	508-2
509	NORTH CORRIDOR 550	OFFICE 509 (DAVE HOHANICK)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	509
510-1	NORTH CORRIDOR 550	COPIER / WORK AREA 510	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	510-1
510-2	PASSAGE 542	COPIER / WORK AREA 510	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	510-2
510-3	NORTH CORRIDOR 550	COPIER / WORK AREA 510	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	3'-0"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	510-3
511	NORTH CORRIDOR 550	OFFICE 511 (SUE LATIN)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	511
512-1	NORTH CORRIDOR 550	OFFICE 512 (ANN PARRISH BARNETT)	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	512-1
512-2	OFFICE 514 (JANEE CORBIN)	OFFICE 512 (ANN PARRISH BARNETT)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	512-2
513	NORTH CORRIDOR 550	OFFICE 513 (GERARD LEONE)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	513
514-1	NORTH CORRIDOR 550	OFFICE 514 (JANEE CORBIN)	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	514-1
514-2	OFFICE 516 (BETH HAGAR)	OFFICE 514 (JANEE CORBIN)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	514-2
515-1	NORTH CORRIDOR 550	BOARD ROOM 515	EXISTING HOLLOW METAL	EXISTING	EXISTING	EXISTING	EXISTING	EXISTING	EXISTING	EXISTING	NO WORK REQUIRED - SHOWN FOR REFERENCE ONLY	N/A	515-1
515-2	SOUTH CORRIDOR 551	BOARD ROOM 515	EXISTING HOLLOW METAL	EXISTING	EXISTING	EXISTING	EXISTING	EXISTING	EXISTING	EXISTING	NO WORK REQUIRED - SHOWN FOR REFERENCE ONLY	N/A	515-2
516-1	NORTH CORRIDOR 550	OFFICE 516 (BETH HAGAR)	EXISTING HOLLOW METAL	EXISTING	2'-8"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	516-1
516-2	OFFICE 520	OFFICE 516 (BETH HAGAR)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	516-2
517-1	RECEPTION 533	OFFICE 517	EXISTING HOLLOW METAL	EXISTING	2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	20	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	517-1
517-2	NORTH CORRIDOR 550	OFFICE 517	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	517-2
519	SOUTH CORRIDOR 551	OFFICE 519	EXISTING HOLLOW METAL	EXISTING	2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	519
520-1	NORTH CORRIDOR 550	OFFICE 520 (JENIFER ASHTON)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	520-1
520-2	NORTH CORRIDOR 550	OFFICE 520 (JENIFER ASHTON)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	520-2



## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - FIFTH FLOOR (CONTINUED)</b>													
521	SOUTH CORRIDOR 551	OFFICE 521 (SEAN ADKINS WITH L. BENNETT)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	521
522	NORTH CORRIDOR 550	JANITOR'S CLOSET 522	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	522
523-1	SOUTH CORRIDOR 551	OFFICE 523 (LAUREN BENNETT)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	523-1
523-2	OFFICE 525 (KYLE WEAVER)	OFFICE 523 (LAUREN BENNETT)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	523-2
524-1	NORTH CORRIDOR 550	OFFICE 524	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	524-1
525-1	SOUTH CORRIDOR 551	OFFICE 525 (KYLE WEAVER)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	525-1
525-2	OFFICE 527 (RHONDA JOHNSON)	OFFICE 525 (KYLE WEAVER)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	525-2
526-1	NORTH CORRIDOR 550	OFFICE 526 (CURT MINER)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	526-1
526-2	NORTH CORRIDOR 550	OFFICE 526 (CURT MINER)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	22	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	526-2
527	SOUTH CORRIDOR 551	OFFICE 527 (RHONDA JOHNSON)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	527
529-1	SOUTH CORRIDOR 551	OFFICE 529 (TRHIS FREY)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	529-1
529-2	OFFICE 531 (LISA BURCHFIELD)	OFFICE 529 (TRHIS FREY)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	529-2
530	SOUTH CORRIDOR 551	OFFICE 530	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE		
531-1	SOUTH CORRIDOR 551	OFFICE 531 (LISA BURCHFIELD)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	531-1
531-2	OFFICE 533	OFFICE 531 (LISA BURCHFIELD)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	531-2
532	SOUTH CORRIDOR 551	OFFICE 532	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	532
533	SOUTH CORRIDOR 551	OFFICE 533	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	533
534A	SOUTH CORRIDOR 551	CONFERNECE ROOM 534	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	534A
534B-1	SOUTH CORRIDOR 451	STORAGE 534B	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	534B-1
534B-2	UNNAMED 544	STORAGE 534B	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	534B-2
535	SOUTH CORRIDOR 551	OFFICE 535 (TEDDI SZYMANSKI)	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	535
537-1	SOUTH CORRIDOR 551	STORAGE & IT 537	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	537-1
537-2	SOUTH CORRIDOR 551	STORAGE & IT 537	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	537-2
540-1	OFFICE 517	NORTH ELECTRICAL ROOM 540	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	540-1

## DOOR SCHEDULE

DOOR NUMBER	DESCRIPTION OF DOOR LOCATION		FRAME ATTRIBUTES		DOOR ATTRIBUTES					HARDWARE SET	SPECIFIC REMARKS	SCOPE ITEM	DOOR NUMBER
	ROOM ON SIDE 1 (OUTSIDE)	ROOM ON SIDE 2 (INSIDE)	MATERIAL	FINISH	SIZE			MATERIAL	FINISH				
					WIDTH	HEIGHT	THICK						
<b>STATE MUSEUM OF PENNSYLVANIA - FIFTH FLOOR (CONTINUED)</b>													
540-2	OFFICE 517	NORTH ELECTRICAL ROOM 540	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	540-2
541A-1	SOUTH CORRIDOR 551	FILE ROOM 541	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	541A-1
541A-2	PASSAGE 547	FILE ROOM 541	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	541A-2
541A-3	OFFICE 543	FILE ROOM 541	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	541A-3
543-1	PASSAGE 542	OFFICE 543	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	543-1
543-2	OFFICE 544	OFFICE 543	EXISTING HOLLOW METAL	EXISTING	(2) 3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	543-2
544	PASSAGE 542	OFFICE 544	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	544
545	PASSAGE 542	OFFICE 545	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	545
546-1	OFFICE 544	OFFICE 546	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	DOOR IS NOT CURRENTLY INSTALLED / RE-HANG DOOR ADJUST DOOR AND HARDWARE PER SPEC 087111	B-3	546-1
546-2	COPIER/WORK AREA 510	OFFICE 546	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	EXISTING	EXISTING WOOD	EXISTING	24	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	546-2
541	OFFICE 543	SOUTH ELECTRICAL 541	EXISTING HOLLOW METAL	EXISTING	3'-0"	6'-8"	EXISTING	EXISTING HOLLOW METAL	EXISTING	25	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-3	541
S503	SOLARIUM 550	STAIR 03 (MUSEUM NORTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S503
S504-1	OFFICE 546	PUBLIC STAIR 04 (MUSEUM CENTRAL STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	6	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S504-1
S504-2	EAST CORRIROR	PUBLIC STAIR 04 (MUSEUM CENTRAL STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	6	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S504-2
S506	CORRIDOR 552	STAIR 06 (MUSEUM SOUTH STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	26	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S506
S604	SOUTH PASSAGE 606	PUBLIC STAIR 04 (MUSEUM CENTRAL STAIR)	EXISTING HOLLOW METAL	EXISTING	(2) 2'-6"	6'-8"	1-3/4"	EXISTING HOLLOW METAL	EXISTING	43	EXISTING DOOR TO REMAIN REFER TO SPECIFICATION 087111 FOR NEW HARDWARE	B-6	S604

## SECTION 081113

### HOLLOW METAL DOORS AND FRAMES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes hollow-metal work.

##### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

##### 1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

##### 1.5 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of anchorages, joints, field splices, and connections.
  - 7. Details of accessories.
  - 8. Details of moldings, removable stops, and glazing.
  - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

- D. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- E. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
  - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Curries Company; an Assa Abloy Group company.
  - 2. HMF Express.
  - 3. Karpen Steel Custom Doors & Frames.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

### 2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

## 2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.
  - 1. Physical Performance: Level A according to SDI A250.4.
  - 2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches (44.5 mm).
    - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.053 inch (1.3 mm).
    - d. Edge Construction: Model 1, Full Flush.
    - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
    - f. Core: Any of the following:
      - 1) Kraft-paper honeycomb.
      - 2) Polystyrene.
      - 3) Polyurethane.
      - 4) Polyisocyanurate.
      - 5) Mineral board.
      - 6) Vertical steel stiffener.
  - 3. Frames:
    - a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch (1.3 mm).
    - b. Construction: Full profile welded.
    - c. Frame Face Profile: Match existing where indicated with tapered face.
  - 4. Exposed Finish: Prime.

## 2.4 FRAME ANCHORS

- A. Jamb Anchors: Provide the following as required for each installation location.
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
  - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
  - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
  - 4. Post-installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
  - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

## 2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

## 2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
  - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
  - 2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
  - 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
  - 4. Top Edge Closures: Close top edges of doors with inverted closures or flush closures of same material as face sheets.
  - 5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
  - 6. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  5. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
      - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
      - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
      - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
    - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
      - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
      - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
      - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
    - c. Compression Type: Not less than two anchors in each frame.
    - d. Post-installed Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
  6. Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.
  7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
  2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
  - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
  - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  - 4. Provide loose stops and moldings on inside of hollow-metal work.
  - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

## 2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## 2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.



### 3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
  
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-rated openings, install frames according to NFPA 80.
    - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - c. Install frames with removable stops located on secure side of opening.
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - g. Field apply bituminous coating to backs of frames that will be filled with grout containing anti-freezing agents.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
  - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
  - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
  - 5. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 6. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
  - 7. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
  
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
  - 1. Non-Fire-Rated Steel Doors:

- a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
  - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
  - c. At Bottom of Door: 3/4 inch (19.1 mm) plus or minus 1/32 inch (0.8 mm).
  - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

## SECTION 083113

### ACCESS DOORS AND FRAMES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Access doors and frames for walls and ceilings.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details materials, individual components and profiles, and finishes.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

#### PART 2 - PRODUCTS

##### 2.1 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Babcock-Davis.
  - 2. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
  - 3. Karp Associates, Inc.
  - 4. Larsen's Manufacturing Company.
  - 5. Milcor Inc.
- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. Flush Access Doors with Exposed Flanges:

1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
2. Locations: CMU wall.
3. Door Size: As indicated on drawings.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
  - a. Finish: Factory prime.
5. Frame Material: Same material, thickness, and finish as door
6. Hinges: Manufacturer's standard.
7. Hardware: Latch.

D. Flush Access Doors with Concealed Flanges:

1. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum or plaster beads for concealed flange installation.
2. Locations: Gypsum board and gypsum plaster wall or ceiling.
3. Door Size: As indicated on drawings.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16-gage.
  - a. Finish: Factory prime.
5. Hinges: Manufacturer's standard.
6. Hardware: Latch.

## 2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same type as door face.

## 2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
  1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
  2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
  3. Provide mounting holes in frames for attachment of units to metal.
  4. Provide mounting holes in frame for attachment of masonry anchors.

- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

## 2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
  - 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

### 3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

## SECTION 084117

### FLUSH ALUMINUM DOORS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Flush aluminum doors to be installed in existing frames.

- B. Related Requirements:

- 1. Section 087111 "Door Hardware" for door hardware for flush aluminum doors.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For doors. Include plans, elevations, sections, full-size details, and attachments to other work.

- 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.

- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

- E. Qualification Data: For Installer.

- F. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing agency.

- G. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.
- H. Source quality-control reports.
- I. Field quality-control reports.
- J. Sample Warranties: For special warranties.
- K. Maintenance Data: For aluminum doors to include in maintenance manuals.

#### 1.4 QUALITY CONTROL

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Professional, except with Professional's approval. If changes are proposed, submit comprehensive explanatory data to Professional for review.
- D. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- E. Accessible Entrances: Comply with applicable provisions in ICC/ANSI A117.1.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum doors that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including, but not limited to, excessive deflection.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - c. Water penetration.
    - d. Failure of operating components.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
  - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
  - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Structural-Sealant Joints:
  1. Designed to carry gravity loads of glazing.

### 2.3 STOREFRONT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide production of one of the following:
  1. EFCO Corporation.
  2. Kawneer North America; an Alcoa Company
  3. TRACO.
  4. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel Company.
  5. YKK AP America, Inc.
  6. Or equal as approved by the Professional.

### 2.4 FLUSH DOORS

- A. Entrance Doors: Manufacturer's flush entrance doors for manual swing.
  1. Door Construction: 3/16-inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded, or that incorporate concealed tie rods.
    - a. Vertical Stile: 5 inches.
    - b. Top Rail: 5 inches.
    - c. Bottom Rail: 5 inches.
  2. Door Face: Architectural quality aluminum sheet 0.090 inches thick.
    - a. Surface Texture: Plain unpatterned.
  3. Door Core: Shall be urethane foam injected at 5 lb./cu.ft. density and shall have "0" O.D.P. = "Zero" Ozone Depletion Potential and contain no chlorofluorocarbons (CFCs) or hydro chlorofluorocarbons (HCFCs).



4. Fasteners: Aluminum, non-magnetic stainless steel or other materials to be non-corrosive and compatible with aluminum-framed flush entrance door members, trim hardware, anchors and other components.
5. Anchors, Clips and Accessories: Aluminum, non-magnetic stainless steel. Provide sufficient strength to withstand design pressure indicated.
6. Reinforcing Members: Aluminum, non-magnetic stainless steel. Provide sufficient strength to withstand design pressure indicated.

## 2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087111 "Door Hardware."
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door, to comply with requirements in Section 087111 "Door Hardware."
  1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
  2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
  3. Opening-Force Requirements:
    - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
    - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
- C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
  1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
  2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Cylinders: As specified in Section 087111 "Door Hardware."
- E. Continuous-Gear Hinges: As specified in Section 087111 "Door Hardware."
- F. Mortise Auxiliary Locks: As specified in Section 087111 "Door Hardware."
- G. Panic Exit Devices: As specified in Section 087111 "Door Hardware."
- H. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- I. Operating Trim: As specified in Section 087111 "Door Hardware."
- J. Closers: As specified in Section 087111 "Door Hardware."

- K. Door Stops: As specified in Section 087111 "Door Hardware."
- L. Weather Stripping: Manufacturer's standard replaceable components.
  - 1. Compression Type: Made of ASTM D 2000 molded neoprene or ASTM D 2287 molded PVC.
  - 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- M. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- N. Thresholds: As specified in Section 087111 "Door Hardware."

## 2.6 FABRICATION – FLUSH DOORS

- A. Fabricate aluminum-framed flush entrance doors in sizes indicated. Include a complete system for assembling components and anchoring doors.
  - 1. Door face sheets shall be architectural quality aluminum sheet 0.090-inch minimum thickness.
- B. Fabricate aluminum-framed flush entrance doors that are reglazeable, when vision lites are used, without dismantling perimeter framing.
  - 1. Door corner construction shall consist of mechanical clip fastening, SIGMA deep penetration plug welds and 1-1/8-inch (29 mm) long fillet welds inside and outside of all four corners.
  - 2. Accurately fit and secure joints and corners. Make joints hairline in appearance.
  - 3. Face sheets shall lap and interlock with stile and rails to create a hollow cavity for the froth-in-place urethane core.
  - 4. Prepare components with internal reinforcement for door hardware.
- C. Weatherstripping: Provide weatherstripping locked into extruded grooves in door panels or frames as indicated on manufacturer's drawings and details.
- D. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## 2.7 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

### 3.3 INSTALLATION

#### A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

#### B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

- C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

- D. Install components plumb and true in alignment with established lines and grades.

- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

- F. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

### 3.4 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

3.5 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Department's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

END OF SECTION 084113

## SECTION 087111

### DOOR HARDWARE

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes:

- 1. Mechanical door hardware for the following:
  - a. Swinging doors.
- 2. Cylinders for door hardware specified in other Sections.
- 3. Electrified door hardware.

- B. Related Sections:

- 1. Section 081113 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames.
- 2. Section 081416 "Flush Wood Doors" for astragals and integral intumescent seals provided as part of labeled fire-rated assemblies.
- 3. Section 083113 "Access Doors and Frames" for access door hardware, except cylinders.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: Details of electrified door hardware, indicating the following:

- 1. Wiring Diagrams: For power, signal, and control wiring and including the following:
  - a. Details of interface of electrified door hardware and building safety and security systems.
  - b. Schematic diagram of systems that interface with electrified door hardware.
  - c. Point-to-point wiring.
  - d. Risers.
  - e. Elevations doors controlled by electrified door hardware.
- 2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

- C. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.
1. Sample Size: Full-size units or minimum 2-by-4-inch (51-by-102-mm) Samples for sheet and 4-inch (102-mm) long Samples for other products.
    - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
- D. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Submittal Sequence: Submit door hardware schedule after submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
  2. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
  3. Content: Include the following information:
    - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
    - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
    - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
    - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
    - e. Fastenings and other pertinent information.
    - f. Explanation of abbreviations, symbols, and codes contained in schedule.
    - g. Mounting locations for door hardware.
    - h. List or related door devices specified in other Sections for each door and frame.
- E. Keying Schedule: Prepared by or under the supervision of Installer, detailing Client Agency's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents
- F. Qualification Data: For Installer and Architectural Hardware Consultant.
- G. Product Certificates: For electrified door hardware, from the manufacturer.
1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- H. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- I. Warranty: Special warranty specified in this Section.

- J. Maintenance Data: For each type of door hardware included in maintenance manuals. Include final hardware and keying schedule.

#### 1.4 QUALITY CONTROL

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Professional, and Department about door hardware and keying.
  - 1. Warehousing Facilities: In Project's vicinity.
  - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
  - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
  - 1. For door hardware, an Architectural Hardware Consultant (AHC).
- C. Source Limitations: Obtain each type of door hardware from a single manufacturer.
  - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- F. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- G. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC/ANSI A117.1.
  - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
  - 2. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
    - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.

4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- H. Keying Conference: Conduct conference at Project site. In addition to Department, Contractor, and Client Agency, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate Client Agency's keying decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
  2. Preliminary key system schematic diagram.
  3. Requirements for key control system.
  4. Requirements for access control.
  5. Address for delivery of keys.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Department.
- D. Deliver keys and permanent cores to the Department by registered mail or overnight package service.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified elsewhere.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Department's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.



## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including excessive deflection, cracking, or breakage.
    - b. Faulty operation of doors and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Three years from date of Final Completion, unless otherwise indicated.
    - a. Exit Devices: Two years from date of Final Completion.
    - b. Manual Closers: 10 years from date of Final Completion.
    - c. Concealed Floor Closers: 25 years from date of Final Completion.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
  - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
  - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by descriptive titles corresponding to requirements specified in Part 2.

### 2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Baldwin Hardware Corporation.
    - b. Hager Companies.
    - c. IVES Hardware; an Ingersoll-Rand company.
    - d. McKinney Products Company; an ASSA ABLOY Group company.
    - e. Stanley Commercial Hardware; Div. of The Stanley Works.

## 2.3 CENTER-HUNG AND OFFSET PIVOTS

### A. Center-Hung and Offset Pivots: BHMA A156.4.

1. Manufacturers: Subject to compliance with requirements, provide the following:
  - a. Rixson Specialty Door Controls; an ASSA ABLOY Group company. NO SUBSTITUTIONS *Pending proprietary specification approval.*

## 2.4 CONTINUOUS HINGES

### A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

### B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bommer Industries, Inc.
  - b. Hager Companies.
  - c. IVES Hardware; an Ingersoll-Rand company.
  - d. McKinney Products Company; an ASSA ABLOY Group company.
  - e. Stanley Commercial Hardware; Div. of The Stanley Works.
  - f. Zero International.
2. Grade: Grade 3-300.
3. Mounting: Full surface, with removable continuous caps over fasteners.

## 2.5 MECHANICAL LOCKS AND LATCHES

### A. Lock Functions: As indicated in door hardware schedule.

### B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
2. Deadbolts: Minimum 1.25-inch (32-mm) bolt throw.

### C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

### D. Lock Trim:

1. Description: As indicated on Hardware Schedule.
2. Levers: Cast.
3. Knobs: Cast.
4. Escutcheons (Roses): Cast.
5. Operating Device: Lever with escutcheons (roses).

- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
  - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  - 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
  - 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
  
- F. Mortise Locks: BHMA A156.13; Operational Grade 2; stamped steel case with steel or brass parts; Series 1000.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Best Access Systems; Div. of Stanley Security Solutions, Inc. NO SUBSTITUTIONS
    - b. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.7, Substitution of Materials, of the General Conditions to the Construction contract does not apply to the above item.

## 2.6 AUXILIARY LOCKS

- A. Bored Auxiliary Locks: BHMA A156.5: Grade 2; with strike that suits frame.
  - 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
    - a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
    - b. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
    - c. Schlage Commercial Lock Division; an Ingersoll-Rand company.
  - 2. Backset: 2-3/4 inches (70 mm).
  - 3. Material: Brass, Bronze or Stainless steel.
  - 4. Deadlatches: Deadlocking latchbolt operated by key either side or key outside and turn inside.
  - 5. Deadlocks: Deadbolt operated by key either side or key outside and turn inside as indicated by Hardware Schedule.

## 2.7 ELECTROMAGNETIC LOCKS

- A. Electromagnetic Locks: BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full-exterior or full-interior type, as required by application indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Door Controls International, Inc.
  - b. Schlage Commercial Lock Division; an Ingersoll-Rand company.
  - c. Securitron Magnalock Corporation; an ASSA ABLOY Group company.
  - d. Security Door Controls.
- 2. Direct-Hold Type: Lock mounted on bottom of header; strike flush mounted on door push side.
  - 3. Strength Ranking: 1000 lbf (4448 N).
  - 4. Inductive Kickback Peak Voltage: Not more than 53 V.
  - 5. Residual Magnetism: Not more than 4 lbf (18 N) to separate door from magnet.

## 2.8 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
    - b. Door Controls International, Inc.
    - c. Hiawatha, Inc.
    - d. IVES Hardware; an Ingersoll-Rand company.
- B. Manual-Extension Flush Bolts: Grade 2, fabricated from extruded brass or aluminum, with 12-inch (305-mm) rod actuated by flat lever; listed and labeled for fire-rated doors. Provide with matching strike.

## 2.9 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Von Duprin; an Ingersoll-Rand company. NO SUBSTITUTIONS
    - b. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.7, Substitution of Materials, of the General Conditions to the Construction contract does not apply to the above item.
- B. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- C. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- D. Surface Vertical-Rod Exit Devices: Grade 2.

1. Type: Type 5, narrow stile.
2. Grade: Grade 2.
3. Actuating Bar: Cross bar.
4. Configuration: Top rod only.

E. Concealed Vertical-Rod Exit Devices: Grade 2.

1. Type: Type 6, narrow stile.
2. Grade: Grade 2.
3. Actuating Bar: Cross bar.
4. Material: Brass or Bronze.
5. Configuration: Top rod only.

## 2.10 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Best Access Systems; Div. of Stanley Security Solutions, Inc. NO SUBSTITUTIONS.
  - b. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.7, Substitution of Materials, of the General Conditions to the Construction contract does not apply to the above item.

B. High-Security Lock Cylinders: BHMA A156.30; Grade 3; Type M, mechanical; permanent cores that are removable; face finished to match lockset.

1. Number of Pins: Seven.
2. Type: Mortise type.

## 2.11 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

1. Great-Grand Master Key System:
  - a. Establish a new grand master key system per the Client Agency's instructions.

B. Keys: Nickel silver or Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
  - a. Notation: "DO NOT DUPLICATE."

C. Quantity: In addition to one key and one extra key blank for each lock, provide the following:

1. Cylinder Change Keys: 3;
2. Master Keys: 10.
3. Grand Master Keys: 10.
4. Great-Grand Master Keys: 10.

## 2.12 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hager Companies.
    - b. IVES Hardware; An Ingersoll-Rand Company.
    - c. Rockwood Manufacturing Company.
- B. Flat Push Plates: 1/8 inch (3.2 mm) thick, with square corners and beveled edges; secured with exposed screws.
- C. Straight Door Pulls: With minimum clearance of 1-1/2 inches (38 mm) from face of door.
  1. Type: 3/4-inch (19-mm) constant-diameter pull.
  2. Mounting: Surface applied with concealed fasteners.

## 2.13 ACCESSORIES FOR PAIRS OF DOORS

- A. Overlapping-with-Gasket Astragals: BHMA A156.22; T-shaped metal, surface mounted on edge of door with screws; with integral gasket and base metal as follows:
  1. Base Metal: Stainless steel.
  2. Gasket Material: Silicone.

## 2.14 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Arrow USA; an ASSA ABLOY Group company.
    - b. DORMA Architectural Hardware; Member of The DORMA Group North America.
    - c. LCN Closers; an Ingersoll-Rand company.
    - d. Norton Door Controls; an ASSA ABLOY Group company.
    - e. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
    - f. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
    - g. Yale Security Inc.; an ASSA ABLOY Group company.

- B. Cast-Aluminum Surface Closers: Grade 2; Traditional Type with mechanism enclosed in cast-aluminum alloy shell.
  - 1. Mounting: Per Hardware Schedule.
  - 2. Type: Per Hardware Schedule.
  - 3. Backcheck: Adjustable, effective between 60 and 85 degrees of door opening.

## 2.15 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hager Companies.
    - b. National Guard Products.
    - c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
    - d. Reese Enterprises, Inc.
    - e. Zero International.
- B. Adhesive-Backed Perimeter Gasketing: Vinyl bulb or Silicone gasket material applied to frame rabbet with self-adhesive.
- C. Automatic Door Bottoms: Sponge neoprene or Sponge silicone gasket material held in place by aluminum housing that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.
  - 1. Mounting: Surface mounted on face of door.
  - 2. Type: Low-closing-force type for doors required to meet accessibility requirements.

## 2.16 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hager Companies.
    - b. National Guard Products.
    - c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
    - d. Reese Enterprises, Inc.
    - e. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
    - f. Zero International.

## 2.17 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Baldwin Hardware Corporation.
  - b. IVES Hardware; an Ingersoll-Rand company.
  - c. Pawling Corporation.
  - d. Rockwood Manufacturing Company.
- B. Armor Plates: 40 inches (1016 mm) high by door width with allowance for frame stops.
- C. Kick Plates: 8 inches (203 mm) high by door width with allowance for frame stops.

## 2.18 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Professional.
  1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  2. Fire-Rated Applications:
    - a. Wood or Machine Screws: For the following:
      - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
      - 2) Strike plates to frames.
      - 3) Closers to doors and frames.
    - b. Steel Through Bolts: For the following unless door blocking is provided:
      - 1) Surface hinges to doors.
      - 2) Closers to doors and frames.
      - 3) Surface-mounted exit devices.
  3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.



4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

## 2.19 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.1 KEY CONTROL SYSTEM

- A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 200 percent of the number of locks.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Key Boxes and Cabinets.
    - b. GE Security, Inc.
    - c. HPC, Inc.
    - d. Lund Equipment Co., Inc.
    - e. MMF Industries.
    - f. Tri Palm International.
  2. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

### 3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
  - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
  - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
  - 1. Furnish permanent cores to Department for installation.
- F. Key Control System: Mount the key control cabinet securely to the wall at the location as determined by the Client Agency.
  - 1. Tag keys and place them on markers and hooks in the key control system cabinet as determined by the final keying schedule.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Department will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
  - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  - 1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
  - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
  - 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately six months after date of Final Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

### 3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Final Completion.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Department's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 017900 "Demonstration and Training."

3.8 DOOR HARDWARE SCHEDULE

NOTES:

1. Where new hardware is indicated to replace existing hardware, i.e. new lockset, remove and dispose of existing hardware.
2. Where existing locksets are indicated to be replaced with new locksets and square roses are not indicated to be reused, salvage rose, mechanically refinish, coat with clear lacquer, box turn over to the Client Agency.
3. Provide 32D blank covers for all locations where cylinders are removed and not replaced.
4. Refer to footnotes at the end of this Section.

B. HARDWARE SET 01 (Scope Item B-3)

8	Hinges	5 x 4½ BB1191	32B	Hager
1	Lockset Storeroom Function	9K3-7-D-16C-STK PREMIUM	626	Best
1	Closer	4021	ALUM	LON
1	Mounting Plate	4020 18G	ALUM	LON
1	Set Flush Bolts	555	26D	Rockwood
4	Protection Plates	K1125 48" x 2" LDW	ALUM DIA	Rockwood
2	Stops	440	26D	Rockwood

C. HARDWARE SET 02 (Scope Item B-3)

1	Cylinder	1574 PREMIUM	626	Best
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Coordinate cylinder type with existing door and hardware. Existing doors bind and do not open freely. Remove each door and adjust for proper, unrestricted opening. Grind and refinish door edges on frame as required.

D. HARDWARE SET 03 (Scope Item B-3)

1	Lockset	9K-3-7-AB-16C-STK <sup>2</sup> PREMIUM	26D	Best
1	Dummy Trim	9K-3-2DT	26D	Best

E. HARDWARE SET 04 (Scope Item B-11)

All existing hardware to be removed and reinstalled on new rated doors.

F. HARDWARE SET 05<sup>10</sup> (Scope Item B-3)

1	Floor Closer	PH-40-N-90	626	Rixson
1	Top Pivot	345	626	Rixson

G. HARDWARE SET 06<sup>15, 16, 22</sup> (Scope Item B-3)

2	Exit Devices	55-47-NL-LBR	US26D	Von Duprin
1	Cylinder	1E74 PREMIUM	626	Best
2	Auto Door Bottoms	434APKL	CLR	Pemko
2	Continous Hinges	780-112HD	CLR ANODIZED	Hager (Roton)
2	Door Closers	4021	ALUM	LCN
1	Threshold	272A	-	Pemko
1	Gasket Set	588BL	-	Pemko
1	Astragal	303AS	-	Pemko

H. HARDWARE SET 07<sup>15, 16, 22</sup> (Scope Item B-3)

2	Exit Devices	55-47-NL-F-LBR	US26D	Von Duprin
2	Auto Door Bottoms <sup>14</sup>	412RL	CLR	Pemko
1	Cylinder	1E74 PREMIUM	626	Best
2	Continous Hinges	780-112HD	CLR ANODIZED	Hager (Roton)
2	Door Closers	4021	ALUM	LCN
1	Threshold	272A	-	Pemko
1	Gasket Set	588BL	-	Pemko
1	Astragal	303AS	-	Pemko

I. HARDWARE SET 08 (Scope Item B-3)

1	Lockset	9K-3-7-D-16C-STK <sup>2</sup> PREMIUM	26D	Best
1	Dead Bolt	8T3-7-L-STK <sup>2</sup> PREMIUM	26D	Best

J. HARDWARE SET 09<sup>9</sup> (Scope Item B-9)

1	Exit Device <sup>8</sup>	55-47-L07-F-LBR	US26D	Von Duprin
1	Cylinder Cover Plate		626	Best
1	Cylinder	1E74 PREMIUM	626	Best

K. HARDWARE SET 10<sup>15, 16, 22</sup> (Scope Item B-3)

2	Exit Devices	55-47-NL-07-LBR	US26D	Von Duprin
1	Cylinder	1E74 PREMIUM	626	Best
2	Auto Door Bottoms	434APKL	CLR	Pemko
2	Continous Hinges	780-112HD	CLR ANODIZED	Hager (Roton)
2	Door Closers	4021	ALUM	LCN
1	Threshold	272A	-	Pemko
1	Gasket Set	588BL	-	Pemko
1	Astragal	303AS	-	Pemko

L. HARDWARE SET 11 (Scope Item B-3)

1	Exit Device	33A-L-07	US26D	Von Duprin
1	Cylinder	1E74 PREMIUM	26D	Best

M. HARDWARE SET 12 (Scope Item B-3)

1	Exit Device	33A-L-07	US26D	Von Duprin
1	Cylinder	1E74 PREMIUM	26D	Best
1	Dead Bolt	8T3-7-L-STK <sup>2</sup> PREMIUM	26D	Best

N.	HARDWARE SET 13 <sup>10, 13</sup> (Scope Item B-11)				
	1	Floor Closer	PH-40-N-90-CWF-LFP	626	Rixson
	1	Top Pivot	345	626	Rixson
	1	Exit Device <sup>7, 11</sup>	CD-33A-27-ED-LBR	US26D	Von Duprin
	1	Cylinder <sup>12</sup>	1E74 PREMIUM	626	Best
	1	Floor Closer Threshold and Cover Plate <sup>20</sup>	276A	AK	Pemko
O.	HARDWARE SET 14 (Scope Item B-3)				
	1	Exit Device	33A-NL-07 <sup>18</sup>	US26D	Von Duprin
	1	Dead Bolt	8T3-7L PREMIUM	26D	Best
	1	Cylinder	1E74 PREMIUM	26D	Best
P.	HARDWARE SET 15 (Scope Item B-3)				
	1	Dead Bolt	49H-K	26D	Best
Q.	HARDWARE SET 16 (Scope Item B-3)				
	1	Deadbolt	49H-M	26D	Best
R.	HARDWARE SET 17 (Scope Item B-3)				
	1	Passage Set	9K-3-N-16C-STK <sup>2</sup>	26D	Best
	1	Indicator Lock	B571	26D	Schlage
S.	HARDWARE SET 18 (Scope Item M-8)				
	6	Hinges <sup>17</sup>	4½x4½ BB1168	26D	Hager
	1	Lockset	8K-3-7-D-4-X <sup>1</sup> -STK <sup>2</sup>	626	Best
	1	Closer	4021	ALUM	LCN
	1	Set Flush Bolts	555	26D	Rockwood
	1	Dust Proof Strike	570	26D	Rockwood
	2	Kick Plate	K1125 6"x2" LDW	32D	Rockwood
	2	Stop	440	26D	Rockwood
T.	HARDWARE SET 19 (Scope Item M-8)				
	6	Hinges	4½x4½ BB1168	26D	Hager
	1	Lockset	8K-3-7-D-4-X <sup>1</sup> -STK <sup>2</sup>	626	Best
	1	Closer	4021	ALUM	LCN
	1	Set Flush Bolts	555	26D	Rockwood
	1	Dust Proof Strike	570	26D	Rockwood
	2	Kick Plates	K1125 6"x2" LDW	32D	Rockwood
	2	Stops	440	26D	Rockwood
U.	HARDWARE SET 20 (Scope Item B-3)				
	1	Passage Set	8K-3-N-4-X <sup>1</sup> -STK <sup>2</sup> PREMIUM	26D	Best

V.	HARDWARE SET 21 (Scope Item B-3)				
1	Deadbolt	8T3-7-K-SK <sup>2</sup> PREMIUM	26D		Best
W.	HARDWARE SET 22 (Scope Item B-3)				
1	Lockset	8K-3-7-AB-4-X <sup>1</sup> -STK <sup>2</sup> PREMIUM	26D		Best
X.	HARDWARE SET 23 (Scope Item B-3)				
1	Lockset	8K-3-7-D-4-X <sup>1</sup> -STK <sup>2</sup> PREMIUM	26D		Best
Y.	HARDWARE SET 24 (Scope Item B-3)				
1	Lockset	9K-3-7-AB-16C-STK <sup>2</sup> PREMIUM	626		Best
Z.	HARDWARE SET 25 (Scope Item B-3)				
1	Lockset	9K-3-7-D-16C-STK <sup>2</sup> PREMIUM	626		Best
AA.	HARDWARE SET 26 (Scope Item B-11)				
2	Exit Devices	55-47-NL-07-F	US26D		Von Duprin
2	Plates	RM1020 Custom thickness & size <sup>3</sup>	32D		Rockwood
1	Cylinder	1E74 PREMIUM	626		Best
1	Gasket Set	S88D	BLK		Pemko
1	Auto Door Bottom	412RL <sup>5</sup>	CLR		Pemko
BB.	HARDWARE SET 27 (Scope Item B-3)				
3	Deadbolts	6T <sup>6</sup> -7-M-STK PREMIUM	626		Best
CC.	HARDWARE SET 28 (Scope Item B-3)				
1	Cylinder	1E74 PREMIUM	626		Best
DD.	HARDWARE SET 29 (Scope Item B-3)				
3	Cylinders	1E74 PREMIUM	626		Best
EE.	HARDWARE SET 30 (Scope Item B-3)				
1	Exit Device	33-27A-L-07-LBR	US26D		Von Duprin
FF.	HARDWARE SET 31 (Scope Item B-3)				
1	Exit Device	33-27A-L-07-LBR	US26D		Von Duprin
GG.	HARDWARE SET 32 (Scope Item B-3)				
1	Lockset	9K3-7-AB-16C-STK <sup>2</sup> PREMIUM	626		Best
1	Closer	4021	ALUM		LCN

HH.	HARDWARE SET 33 (Scope Item B-3)				
	1	Exit Device	33-27A-NL-07-LBR	US26D	Von Duprin
II.	HARDWARE SET 34 (Scope Item B-3)				
	1	Lockset	9K-3-7-AB-16C-STK <sup>2</sup> PREMIUM	626	Best
	1	Dummy Trim	16C	626	Best
JJ.	HARDWARE SET 35 (Scope Item B-3)				
	1	Deadbolt	49H-K	626	Best
KK.	HARDWARE SET 36 (Scope Item B-3)				
	1	Lockset	9K-3-7-C-16C-STK <sup>2</sup> PREMIUM	626	Best
LL.	HARDWARE SET 37 (Scope Item B-3)				
	1	Exit Device <sup>7</sup>	33-27A-NL-07-LBR	US26D	Von Duprin
	1	Exit Device <sup>7</sup>	55-47-NL-07-F-LBR	US26D	Von Duprin
MM.	HARDWARE SET 38 (Scope Item B-9)				
	2	Exit Devices	5547-WDC-BE-LBR	US26D	Von Duprin
NN.	HARDWARE SET 39				
	2	Cylinders	1E74 PREMIUM	626	Best
OO.	HARDWARE SET 40				
	2	Floor Closers	PH-28-N-90	626	Rixson
	2	Top Pivots	340	626	Rixson
PP.	HARDWARE SET 41 <sup>13, 19</sup>				
	2	Floor Closers	PH-28-N-90-CWF-LFP	626	Rixson
	2	Top Pivots	340	626	Rixson
	2	Exit Devices	55-47-L-07-LBR	US26D	VonDuprin
	2	Cylinders	IE74 PREMIUM	26D	Best
	1	Floor Closer Threshold and Cover Plate <sup>20</sup>	276A	AK	Pemko
QQ.	HARDWARE SET 42 <sup>13, 19, 21</sup>				
	2	Floor Closers	PH-28-N-90-CWF-LFP	626	Rixson
	2	Top Pivots	340	626	Rixson
	2	Exit Devices	55-47-L-07-LBR	US26D	VonDuprin
	2	Cylinders	IE74 PREMIUM	26D	Best
	1	Floor Closer Threshold and Cover Plate <sup>20</sup>	276A	AK	Pemko



RR. HARDWARE SET 43

2	Exit Devices	55-47-L-07	US26D	VonDuprin
2	Plates	RM 1020 Custom Thickness and size <sup>3</sup>	32D	Rockwood
1	Cylinder	IE74 PREMIUM	26D	Best

1. Salvage existing square roses, mechanically refinish and coat with clear lacquer.
2. Confirm strike fits existing hollow metal frame prep.
3. Provide custom size 3½" wide x 15" high x .125" thickness. Punch or drill to accept cylinder and Von Duprin trim.
4. Adjust closer speed to provide latching of rated doors.
5. Remove fixed surface door bottom.
6. Field verify existing door thickness.
7. Field measure for extra-long top rod.
8. Take doors to millwork shop to prep for concealed vertical rod exit devices.
9. All existing hardware to remain, except remove existing dead lock and cylinder.
10. Replace floor stop with new to match existing.
11. Reuse existing aluminum channel to conceal vertical rod.
12. Provide two (2) cylinders at Door M116E.
13. Replace all weather proofing.
14. Locate astragal at interior side of doors.
15. Adjust closer speed to provide proper latch of doors.
16. Cut or grind door bottom to remove drag of door when closing.
17. Field confirm existing hinge prep.
18. Reuse existing pull; modify NL trim as required.
19. Shop prep door for concealed vertical rod. Provide temporary enclosure while door is at shop.
20. Field verify dimensions of existing threshold and match new to existing.
21. Remove surface door closers. Patch all holes.
22. Remove floor close, abandon case in place and grout solid. Remove top pivot patch holes.

END OF SECTION 087111

## SECTION 092116

### GYPSUM BOARD SHAFT WALL ASSEMBLIES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes: Gypsum board shaft wall assemblies.

##### 1.3 SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

##### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

### 2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: 1 hour.
- B. STC Rating: Not required.
- C. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
  - 1. Depth: 2-1/2 inches (64 mm).
  - 2. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
- D. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm) long and matching studs in depth.
  - 1. Minimum Base-Metal Thickness: Matching steel studs.
- E. Room-Side Finish: Gypsum board.
- F. Shaft-Side Finish: Gypsum shaftliner board, Type X.
- G. Insulation: Not required.

### 2.3 PANEL PRODUCTS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. Gypsum Shaftliner Board, Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; ProRoc Shaftliner.
    - b. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; ToughRock Fireguard Shaftliner.
    - c. Lafarge North America, Inc.; Firecheck Type X Shaftliner.
    - d. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
    - e. PABCO Gypsum; Pabcore Shaftliner Type X.
    - f. USG Corporation; Sheetrock Brand Gypsum Liner Panel.
  - 2. Thickness: 1 inch (25.4 mm).
  - 3. Long Edges: Double bevel.
- C. Gypsum Board: As specified in Section 092900 "Gypsum Board."

## 2.4 NON-LOAD-BEARING STEEL FRAMING

- A. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  - 1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120) unless otherwise indicated.

## 2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
  - 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
  - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fireproofing."

- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

### 3.3 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

### 3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092116

## SECTION 092216

### NON-STRUCTURAL METAL FRAMING

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
  - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

##### 2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  - 2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.

1. Steel Studs and Runners:
  - a. Minimum Base-Metal Thickness: 20-gauge.
  - b. Depth: 3-5/8 inches (92 mm).
2. Dimpled Steel Studs and Runners:
  - a. Minimum Base-Metal Thickness: 20-gauge.
  - b. Depth: 3-5/8 inches (92 mm).
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
- D. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
  1. Depth: 1-1/2 inches (38 mm).
  2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- E. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
  1. Depth: 3/4 inch (19 mm).
  2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
  3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- F. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required to fit insulation thickness indicated.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
  1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
    - a. Type: Post-installed, chemical anchor.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
  1. Depth: 2-1/2 inches (64 mm).

- E. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
  - 2. Steel Studs and Runners: ASTM C 645.
    - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
    - b. Depth: 1-5/8 inches (41 mm).
  - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
    - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    - b. Chicago Metallic Corporation; Drywall Grid System.
    - c. USG Corporation; Drywall Suspension System.

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
  - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
  - 3. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.



- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.3 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: 24 inches (610 mm) o.c. unless otherwise indicated.
  - 2. Multilayer Application: 24 inches (610 mm) o.c. unless otherwise indicated.
- B. Install studs so flanges within framing system point in same direction.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
  - 1. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 2. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 3. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- D. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

### 3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Hangers: 48 inches (1219 mm) o.c.
  - 2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
  - 3. Furring Channels (Furring Members): 24 inches (610 mm) o.c.

- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 4. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
- D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092300  
GYPSUM PLASTERING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Gypsum plasterwork on expanded-metal lath and unit masonry for patching of existing partitions and in-fill work.

B. Related Sections:

1. Section 092400 "Portland Cement Plastering" for exterior portland cement plaster (stucco) and associated laths.
2. Section 092613 "Gypsum Veneer Plastering" for gypsum-based veneer plaster applied on gypsum base for veneer plaster, unit masonry, and monolithic concrete.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.

1.4 QUALITY CONTROL

- A. Sound Transmission Characteristics: Where indicated, provide gypsum plaster assemblies identical to those of assemblies tested for STC ratings per ASTM E 90 and classified according to ASTM E 413 by a qualified testing agency.

- B. Mockups: Before plastering, install mockups of one of the areas requiring plaster patching.

1. Mockups shall be 48 x 48 inches minimum size.
2. Install mockups for the following applications:
  - a. Troweled Finishes: Surfaces indicated to receive non-textured paint finishes.
  - b. Surfaces with textured finishes.
3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Final Completion.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

## 1.6 PROJECT CONDITIONS

- A. Comply with ASTM C 842 requirements or gypsum plaster manufacturer's written recommendations, whichever are more stringent.
- B. Room Temperatures: Maintain temperatures at not less than 55 deg. F (13 deg. C) or greater than 80 deg. F (27 deg. C) for at least seven days before application of gypsum plaster, continuously during application, and for seven days after plaster has set or until plaster has dried.
- C. Avoid conditions that result in gypsum plaster drying out too quickly.
  - 1. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
  - 2. Maintain relative humidity levels for prevailing ambient temperature that produce normal drying conditions.
  - 3. Ventilate building spaces in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

## PART 2 - PRODUCTS

### 2.1 EXPANDED-METAL LATH

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
  - 2. CEMCO.
  - 3. Clark Western Building Systems.
  - 4. Dietrich Metal Framing; a Worthington Industries company.
  - 5. MarinoWARE.
  - 6. Phillips Manufacturing Co.
- B. Expanded-Metal Lath: ASTM C 847, cold-rolled carbon-steel sheet, ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coated.
  - 1. Paper Backing: Kraft paper factory bonded to back of lath.
  - 2. Diamond-Mesh Lath: Self-furring, 3.4 lb/sq. yd. (1.8 kg/sq. m).

### 2.2 ACCESSORIES

- A. General: Comply with ASTM C 841 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
- B. Metal Accessories:

- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
  2. CEMCO.
  3. Clark Western Building Systems.
  4. Dietrich Metal Framing; a Worthington Industries company.
  5. MarinoWARE.
  6. Phillips Manufacturing Co.
  7. Cornerite: Fabricated from expanded-metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
  8. Striplath: Fabricated from expanded-metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
  9. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.
    - a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
  10. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.

### 2.3 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Bonding Compound: ASTM C 631.
- C. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.
- D. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 841.
- E. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

### 2.4 BASE-COAT PLASTER MATERIALS

- A. Base-Coat Plasters, General: ASTM C 28/C 28M.
- B. Gypsum Neat Plaster: For use with job-mixed aggregates.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. National Gypsum Company; Gold Bond Two-Way Hardwall Plaster.
    - b. USG Corporation; Red Top Gypsum Plaster.
- C. Aggregates for Base-Coat Plasters: ASTM C 35, sand and perlite.

## 2.5 FINISH-COAT PLASTER MATERIALS

- A. Gypsum Ready-Mixed Finish Plaster: Manufacturer's standard, mill-mixed, gaged, interior finish.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. National Gypsum Company; Gold Bond Kal-Kote Smooth.
    - b. USG Corporation; Diamond Brand Interior Finish Plaster.
- B. Lime: ASTM C 206, Type S, special finishing hydrated lime.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. USG Corporation; Ivory or Snowdrift Finish Lime.

## 2.6 SPRAY ACOUSTICAL FINISH

- A. Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. International Cellulose Corp.; SonaSpray "fc."
    - b. USG Corporation; USG Acoustical Plaster Finish.
  - 2. Application Thickness: 1/2 inch (12.7 mm).
  - 3. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 50 or less.
  - 4. NRC: 0.55 according to ASTM C 423.

## 2.7 PLASTER MIXES

- A. Mixing: Comply with ASTM C 842 and manufacturer's written instructions for applications indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine nonstructural and structural metal framing, substrates, and hollow-metal frames, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

### 3.3 INSTALLING EXPANDED-METAL LATH

- A. Expanded-Metal Lath: Install according to ASTM C 841.
  - 1. Partition Framing and Vertical Furring: Install diamond-mesh lath.
  - 2. Flat-Ceiling and Horizontal Framing: Install diamond-mesh lath.

### 3.4 INSTALLING ACCESSORIES

- A. General: Install according to ASTM C 841.
- B. Cornerbeads: Install at external corners.
- C. Casing Beads: Install at terminations of plasterwork, except where plaster passes behind and is concealed by other work and where metal screeds, bases, or frames act as casing beads.

### 3.5 PLASTER APPLICATION

- A. General: Comply with ASTM C 842.
  - 1. Do not deviate more than plus or minus 1/8 inch in 10 feet (3.1 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.
  - 2. Grout hollow-metal frames, bases, and similar work occurring in plastered areas, with base-coat plaster material, before lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout at least 6 inches (152 mm) at each jamb anchor.
  - 3. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
  - 4. Provide plaster surfaces that are ready to receive field-applied finishes indicated.
- B. Bonding Compound: Apply on unit masonry plaster bases.
- C. Base Coats:
  - 1. Base Coats over Expanded-Metal Lath: Gypsum neat plaster with job-mixed sand for scratch and brown coats.
  - 2. Base Coats over Expanded-Metal Lath:
    - a. Scratch Coat: Gypsum; neat or with job-mixed sand.
    - b. Brown Coat: Gypsum neat plaster with job-mixed sand.
  - 3. Base Coats over Unit Masonry: Gypsum neat plaster with job-mixed sand.

D. Finish Coats:

1. Finish-Coat Mix for Smooth-Troweled Finishes: Gypsum ready-mixed finish plaster.
2. Finish-Coat Mix for Sprayed Finishes: Gypsum ready-mixed finish plaster.

E. Plaster Finishes:

1. Provide troweled finish unless otherwise indicated.
2. Provide sprayed finish for ceiling patches.
  - a. Sprayed Finish: Match existing.

3.6 PLASTER REPAIRS

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 092300



## SECTION 092900

### GYPSUM BOARD

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Interior gypsum board.

- B. Related Requirements:

- 1. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.
  - 2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product.

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

##### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

- B. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

- 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

### 2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### 2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Lafarge North America Inc.
5. National Gypsum Company.
6. USG Corporation.

- B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

- C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.

### 2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic.
2. Shapes:
  - a. Cornerbead.
  - b. Bullnose bead.
  - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - d. L-Bead: L-shaped; exposed long flange receives joint compound.

### 2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.

- B. Joint Tape:
  - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
  - 2. Fill Coat: For second coat, use drying-type, all-purpose compound.
  - 3. Finish Coat: For third coat, use drying-type, all-purpose compound.

## 2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
  - 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Laminating adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Joint Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
    - b. Grabber Construction Products; Acoustical Sealant GSC.
    - c. Pecora Corporation; AC-20 FTR.
    - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
    - e. USG Corporation; SHEETROCK Acoustical Sealant.
  - 2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- H. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
  - 2. Type X: As indicated on Drawings and where required for fire-resistance-rated assembly.
- B. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
  - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
  - 1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
  - 2. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

### 3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners unless otherwise indicated.
  - 2. L-Bead: Use where indicated.
- C. Aluminum Trim: Install in locations indicated on Drawings.

### 3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

- C. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1 Memorial Hall: Ceiling plenum area and other concealed areas.
  - 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in other Section 099123 "Interior Painting." Level 5 is suitable for surfaces receiving gloss and semi-gloss enamels and other surfaces subject to severe lighting. It is considered a high-quality gypsum board finish.

### 3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

## SECTION 095113

### ACOUSTICAL PANEL CEILINGS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
  - 1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
  - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.
- D. Qualification Data: For testing agency.
- E. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- F. Field quality-control reports.
- G. Maintenance Data: For finishes to include in maintenance manuals.

##### 1.4 QUALITY CONTROL

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical ceiling area as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

#### 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
  2. Smoke-Developed Index: 50 or less.

#### 2.2 ACOUSTICAL PANELS, GENERAL

- A. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Source Limitations:
  1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
  2. Suspension System: Obtain each type from single source from single manufacturer.



- C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
  - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.
- E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Professional from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

### 2.3 ACOUSTICAL PANELS APC-1

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Radar Climplus Item No. 2415; USG Interior, Inc.; Subsidiary of USG Corporation, or comparable product by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corp.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
  - 1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
  - 2. Pattern: CE (perforated, small holes and lightly textured).
- C. Color: White.
- D. LR: Not less than 0.84.
- E. NRC: Not less than 0.85.
- F. CAC: Not less than 35.
- G. Edge/Joint Detail: Square.
- H. Thickness: 5/8 inch (15 mm).
- I. Modular Size: 24 by 48 inches (610 by 1220 mm).
- J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

## 2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
  - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated with capability to sustain, without failure, a load equal to 5 times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: Post-installed expansion or Post-installed bonded anchors.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- (3.5-mm-) diameter wire.

## 2.5 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide DGL; USG Interiors, Inc.; Subsidiary of USG Corporation, or comparable product by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corp.
  - 3. Chicago Metallic Corporation.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; pre-painted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
  - 1. Structural Classification: Intermediate-duty system.
  - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
  - 3. Face Design: Flat, flush.
  - 4. Cap Material: Aluminum cold-rolled sheet.
  - 5. Cap Finish: Painted white.

## 2.6 METAL EDGE MOLDINGS AND TRIM <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corp.
  - 3. Chicago Metallic Corporation.
  - 4. Fry Reglet Corporation.
  - 5. Gordon, Inc.
  - 6. USG Interiors, Inc.; Subsidiary of USG Corporation.

- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
  - 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
  - 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
  - 1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
  - 2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

### 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  5. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
  6. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans, or install panels with pattern running in one direction parallel to long axis of space.
  2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

#### 3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

## SECTION 096513

### RESILIENT BASE AND ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Resilient base.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

##### 1.4 QUALITY CONTROL

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg. F (10 deg. C) or more than 90 deg. F (32 deg. C).

#### PART 2 - PRODUCTS

##### 2.1 RESILIENT BASE RB-1

- A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Allstate Rubber Corp.; Stoler Industries.
  - b. Armstrong World Industries, Inc.
  - c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
  - d. Flexco, Inc.
  - e. Johnsonite.
  - f. Musson, R. C. Rubber Co.
  - g. Roppe Corporation, USA.
  - h. VPI, LLC; Floor Products Division.
- B. Resilient Base Standard: ASTM F 1861.
  1. Material Requirement: Type TS (rubber, vulcanized thermoset).
  2. Manufacturing Method: Group I (solid, homogeneous).
  3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch (3.2 mm).
- D. Height: 4 inches (102 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Job formed or preformed.
- H. Finish: Matte.
- I. Colors and Patterns: As selected by Professional and Client Agency from full range of industry colors.

## 2.2 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
  1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Inside Corners: Use straight pieces of maximum lengths possible.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

END OF SECTION 096513



## SECTION 096519

### RESILIENT TILE FLOORING

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Rubber floor tile for Elevator 7.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- C. Maintenance Data: For each type of floor tile to include in maintenance manuals.

##### 1.4 QUALITY CONTROL

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

##### 1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
  2. During installation.
  3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install floor tile after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 RUBBER FLOOR TILE RT-1

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Envire; Roppe Corporation, USA, or an equivalent product by one of the following as approved by the Professional:
1. Endura Rubber Flooring, a division of Burke Industries Inc..
  2. Mondo Rubber International, Inc.
  3. Nora Rubber Flooring, Freudenberg Building Systems, Inc.
  4. R.C.A. Rubber Company (The).
- B. Tile Standard: ASTM F 1344, Class I-A, homogeneous rubber tile, solid color.
- C. Hardness: Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer per ASTM D 2240.
- D. Wearing Surface: Smooth.
- E. Thickness: 0.125 inch (3.2 mm).
- F. Size: 24 by 24 inches (610 by 610 mm).
- G. Colors and Patterns: Match Professional's sample.
1. No. AS617 Terra Cotta; Envire® Roppe.

### 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Rubber Floor Adhesives: Not more than 60 g/L.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install floor tiles until they are same temperature as space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles square with the elevator car.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, non-staining marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

#### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 099123  
INTERIOR PAINTING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Concrete masonry units (CMU).
  - 2. Steel.
  - 3. Wood.
  - 4. Gypsum board.
  - 5. Plaster.
  - 6. Spray-textured ceilings.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

## 1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg. F (10 and 35 deg. C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg. F (3 deg. C) above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Behr Process Corporation.
2. M.A.B. Paints.
3. PPG Architectural Finishes, Inc.
4. Pratt & Lambert.
5. Sherwin-Williams Company (The).

### 2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Non-flat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

C. Colors: Match Architect's samples.

1. P-1: SW6991 "Black Magic," Sherwin Williams.

## 2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: 1LP-1.

1. Basis-of-Design Product: Harmony Latex Primer; Sherwin Williams.

## 2.4 METAL PRIMERS

A. Acrylic Metal Primer: 1MP-1.

1. Basis-of-Design Product: Harmony Latex Flat; Sherwin Williams.

## 2.5 BLOCK FILLER

A. Interior Latex-Based Block Filler:

1. Latex Block Filler: BF-1.
  - a. Basis-of-Design Product: Prep Rite Block Filler; Sherwin Williams.

## 2.6 LATEX PAINTS

A. Interior Latex (Flat): IL-1.

1. Basis-of-Design Product: Pro Industrial Waterborne Acrylic Dryfall Flat; Sherwin Williams.

B. Interior Latex (Eggshell): IL-2.

1. Basis-of-Design Product: Harmony Latex Eg-Shell; Sherwin Williams.

C. Interior Latex (Semi-Gloss): IL-3.

1. Basis-of-Design Product: Harmony Latex Semi-Gloss; Sherwin Williams.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (Clay and CMU): 12 percent.
  - 3. Wood: 15 percent.
  - 4. Gypsum Board: 12 percent.
  - 5. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.



- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
  - 1. SSPC-SP 2, "Hand Tool Cleaning."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Limits:

1. Paint all wall surfaces in rooms where new partitions are added.
2. Paint the entire ceiling where ceilings are patched.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
  1. Latex Over Acrylic Primer System.
    - a. Prime Coat: IMP-1. (Touch-up factory primer as required.)
    - b. Intermediate Coat: IL-3.
    - c. Topcoat: IL-3.
- B. Gypsum Board and Gypsum Plaster Substrates:
  1. Latex System.
    - a. Prime Coat: ILP-1.
    - b. Intermediate Coat: IL-2.
    - c. Topcoat: IL-2.
- C. Concrete Masonry Unit Substrates:
  1. Latex System Over Latex Block Filler:
    - a. Prime Coat: BF-1.
    - b. Intermediate Coat: IL-2.
    - c. Topcoat: IL-2.
- D. Textured Ceiling Substrates:
  1. Latex System:
    - a. Prime Coat: ILP-1.
    - b. Intermediate Coat: IL-1
    - c. Topcoat: IL-1.

END OF SECTION 099123

## SECTION 099600

### HIGH-PERFORMANCE COATINGS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:

- 1. Interior Substrates:

- a. Passenger elevator existing hoistway frames and doors.
    - b. Passenger elevator existing car shell.
    - c. Freight elevator existing hoistway frames and doors.
    - d. Freight elevator car components.
    - e. Other steel components of elevators indicated to be painted as follows:

- 1) Steel components.

- B. Related Requirements:

- 1. Section 099123 "Interior Painting" for general field painting.

##### 1.3 DEFINITIONS

- A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

##### 1.4 SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

- 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. Indicate VOC content.

- B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

#### 1.5 QUALITY CONTROL

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. The Professional will select one passenger elevator hoistway frame and door for application of specified coating system.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Professional at no added cost to Department.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Professional specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg. F (7 deg. C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.7 FIELD CONDITIONS

- A. Apply coatings only when the temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg. F (10 and 35 deg. C).
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg. F (3 deg. C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturers: Provide specified products of The Sherwin Williams Company, or an equivalent product by one of the following as approved by the Professional:
  - 1. PPG Architectural Finishes, Inc.
  - 2. Tnemec.
  - 3. Other manufacturer as approved by the Professional.
- B. Products: Subject to compliance with requirements, provide product listed in other Part 2 Articles for the paint category indicated or equivalent products from one of the other manufacturers listed.

### 2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
  - 3. Products shall be of same manufacturer for each coat in a coating system.
- C. Colors: As indicated in the interior color schedule, Section 099123 and as follows:
  - 1. For example, HPC9 = PT-9 = SW6991 "Black Magic;" Sherwin Williams.
  - 2. EFC-1: General polymers 3505 stipple epoxy float coating, color GP3505A56 "Silver Grey."

### 2.3 METAL PRIMERS

- A. Acrylic Primer: MP-1.
  - 1. Basis-of-Design Product: Kem Bond HS Universal Metal Primer; Sherwin Williams, or equal as approved by the Professional.

### 2.4 POLYURETHANE COATINGS

- A. Polyurethane, Two-Component, Pigmented, Gloss: PC-1.
  - 1. Basis-of-Design Product: Acrolon 218 B65-600; Sherwin Williams, or equal as approved by the Professional.

## 2.5 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Department reserves the right to invoke the following procedure:
1. The Department will engage the services of a qualified testing agency to sample coating materials. The Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to the Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by the testing agency.
  2. The Testing agency will perform tests for compliance with product requirements.
  3. Department may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

## 2.6 COLOR SELECTIONS

- A. Passenger Elevator 7 Existing Hoistway Frame and Doors: Match existing.
- B. Passenger Elevator 7 Car Steel: Black.
- C. Freight Elevator 8 Components: Black.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
  - 1. SSPC-SP 5 white metal commercial blast cleaning.
    - a. Provide for Passenger Elevator 7 existing hoistway frames and doors.
  - 2. SSPC-SP 3 power tool cleaning.
    - a. Provide for the following:
      - 1) Passenger Elevator 7 car shell.
      - 2) Freight Elevator 8 steel components indicated to be painted.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

### 3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
  - 1. Use applicators and techniques suited for coating and substrate indicated.
  - 2. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Department may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At the end of each workday, remove rubbish, cans, rags and other discarded materials from the Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Professional, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

### 3.6 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

#### A. Steel Substrates:

1. Pigmented Polyurethane over Primer:
  - a. Prime Coat: MP-1.
  - b. First Topcoat: PC-1.
  - c. Second Topcoat: PC-1.
  - d. Application: Provide the following:
    - 1) Spray: Provide for Passenger Elevator 7 existing hoistway frames, doors and car shell.
    - 2) Brush or Roller: Provide for components of Freight Elevator 8 and car top components of Passenger Elevator 7.

END OF SECTION 099600



## SECTION 142001

### ELECTRIC TRACTION ELEVATOR MODERNIZATION

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes modernization of electric traction passenger Elevator No. 7.
- B. Related Requirements:
  - 1. Section 099600 "High Performance Coatings" for field painting of steel hoistway frames, doors and car steel.
  - 2. Division 09 for finish flooring in elevator cars.
  - 3. Section 142113 "Electric Traction Freight Elevators" for modernization of electric traction Elevator No. 8.
  - 4. Section 283111 "Digital, Addressable Fire-Alarm System" Fire-Alarm System" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

##### 1.3 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

##### 1.4 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
  - 2. Include large-scale layout of car-control station and standby power operation control panel.
  - 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.

- D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 12-inch-square Samples of sheet materials; and 12-inch lengths of running trim members.
- E. Qualification Data: For Installer.
- F. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.
- G. Sample Warranty: For special warranty.
- H. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified elsewhere for Operation and Maintenance Data, include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- I. Inspection and Acceptance Certificates and Operating Permits: As required by the Pennsylvania Department of Labor & Industry (L&I) Elevator Division unrestricted elevator use.
  - 1. Contractor shall prepare the L&I Elevator Division LIBI-26 Application for Construction and Alteration of a Lifting Device.
    - a. Coordinate seal and signature of the application with the Professional.
  - 2. Contractor shall provide a variance from the L&I Elevator Division for all existing non-complying conditions in the elevator machine room, such as the clearances beneath the transverse beams bisecting the machine room.

#### 1.5 QUALITY CONTROL

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

#### 1.6 CONTRACTOR'S SUPERINTENDENT

- A. The Contractor shall assign a competent project superintendent and Labor during the work progress and any necessary assistant, all satisfactory to the Department and the Professional. The superintendent shall represent the Contractor and all instructions given to him shall be as binding as if given to the Contractor.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

## 1.8 COORDINATION

- A. Coordinate locations and dimensions of other work relating to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

## 1.9 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
- Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
  - Warranty Period: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL DESCRIPTION

- A. Elevators PE7. A Total of one (1) Elevator:

1. Quantity:	One (1) Passenger Elevator
2. Type:	Geared Overhead Traction
3. Capacity (lbs.):	PE7 - 2500 / Retain Existing
4. Speed (fpm):	PE7 – 300 F.P.M. / Retain Existing
5. Travel in Feet:	Field Verify / Retain Existing
6. Number of Landings:	PE7 – – Six (6) @ G, 1, 2, 3, 4, 5
7. Front:	PE7 - – Six (6) @ G, 1, 2, 3, 4, 5 Retain Existing
8. Rear:	None
9. Operation:	PE7 – Simplex Operation (New)
10. Control:	Microprocessor Control (New)
11. Number of Pushbutton Risers	One riser (1) (New)
12. Platform Size:	PE7 – 46" x 80" Retain Existing
13. Guide Rails:	Steel T's / Retain Existing
14. Buffers:	Hydraulic Buffers / Retain Existing
15. Cab Enclosure:	Refer to cab drawings for modernization
16. Car Door Size:	PE7 – 40" x 84"
17. Hoistway Door Size:	PE7 – 40" x 84"
18. Door Operation:	Side Speed Side Slide – steel doors (New car door panels – New Door Operators)
19. Fixture and Signals:	Standard Fixtures (New)
20. Machine Type:	Geared Traction (New)
21. Machine Location:	Overhead
Power Supply:	480 VAC / 3 Phase / 60 HZ (Confirm and retain existing)

## 2.2 CONTROL FEATURES/FUNCTIONS

### A. Simplex Automatic Selective Collective Operation (New)

1. The elevator shall automatically travel to landings for which a call demand exists. Stops in response to calls that are registered in either the car or corridor push-button stations shall occur in the natural order of progression in which the floors are encountered, depending on the direction of car travel, and irrespective of the order in which calls are registered. In responding to corridor calls, the elevator shall answer only those demands that correspond to the direction in which the car is traveling.
2. Call acknowledgment lights provided in both the car and corridor push-button fixtures shall be extinguished as the car begins its slowdown approach to the corresponding landing. Immediately after cancellation, a corridor call shall be inoperative until the elevator doors have completed their dwell time in the open position and commenced their closing cycle.

### B. Motion Control (New)

1. Smooth stepless acceleration and deceleration of the elevator car shall be provided in either direction of travel during both single and multiple floor runs. The amplitude of acceleration and deceleration shall not exceed  $4.5 \text{ ft/sec}^2$ . The maximum velocity which the elevator achieves in either direction of travel while operating under load conditions that vary between empty car and full rated load shall be within  $\pm 2\%$  of the rated speed.
2. Floor leveling accuracy of  $\pm 1/4"$  as measured between the car entrance threshold and the landing sill on any given floor shall be provided. This accuracy standard shall be maintained under varying load conditions and without need for releveling corrections caused by overshooting or stopping short of the floor (spotting).
3. Brake-to-brake elapsed time during a typical elevator one floor run shall not exceed 5.5 seconds. Timing, as measured between initial brake lift and the moment the brake sets with the car position level at the next adjacent floor, shall remain consistent under varying load conditions in either direction of travel.
4. Elapsed flight time during a typical elevator one floor run shall not exceed 12.0 seconds. Timing, as measured between the moment door closing operations begin and when the doors are  $3/4"$  open at the next adjacent floor, shall remain consistent under varying load conditions in either direction of travel. Pre-opening operation shall be available should it be requested by ownership or their representative.

### C. Car/Landing Door Operation (New)

1. Car and landing doors shall be arranged to operate in unison without excessive noise or slamming in either direction of travel. Door opening speeds of two (2) feet per second shall be provided in conjunction with closing speeds of 1.0 foot per second in accordance with governing code. Door operation shall be arranged to commence as the car enters its final leveling approach to a landing. In no case shall the door opening cycle conclude before the car comes to a complete stop at floor level.
2. Door open and door close elapsed time shall be measured between the moment car door operation in either direction begins and the instant at which that particular cycle is completed.
3. When responding to either a car or corridor call, the amount of time that the elevator doors remain stationary in the open position shall be adjustable anywhere up to sixty (60) seconds. Door open dwell time for corridor calls shall be separate of that for car calls, and in both cases, dwell time shall be canceled whenever any of the infrared beams projected across the car entrance are momentarily interrupted by passenger transfers, followed by a reduced door open dwell time of approximately one (1) second (adjustable) after the beam is reestablished.

4. Where door protective devices are provided, the operation of the device by physical contact (mechanical safety-edge) or the interruption of one or more infrared light beams (dual or multi-beam non-contact) during the close cycle shall cause the immediate reversing of the doors to the full open position.
5. The door closing cycle shall be arranged so that, in the event the door protective devices become continually obstructed after the normal door open dwell time has expired, and following a time interval of approximately thirty (30) seconds (adjustable), a warning tone shall sound and the door closing cycle shall commence at reduced speed and torque per ASME A17.1 Code requirements.
6. Each new car operating station shall be provided with a "door open" pushbutton. Pressure on the "door open" button shall cause doors in the full open position to remain so and doors engaged in the close cycle to reverse direction and assume the full open position so long as pressure remains applied to the button. The "door open" buttons shall also control the open cycle during Phase II - Emergency In-car Operation. The "door close" pushbutton shall function on Independent Service, Attendant Service or Phase II - Emergency In-car Operation as well as during normal automatic operations.
7. Repeated attempts by the power door operator mechanisms to open or close the doors at any landing shall be monitored by the new microprocessor-control system. In the event the doors should fail to cycle properly after a preset (adjustable) number of attempts, the car shall either travel to the next stop or remove itself from service, depending upon whether the malfunction is in the open or close cycle.
8. Each set of landing doors shall be provided with an automatic self-closing mechanism arranged so that, if for some reason the car should leave the landing while the landing doors are unlocked, the closing device shall immediately close and lock the doors.
9. Car doors shall be arranged so as to prevent their being manually opened from inside the car unless the elevator is positioned within a floor landing zone.

D. Car Door Operation (New)

1. Car door shall be arranged to operate in unison with the corridor door safety interlock release mechanism. Car door opening speeds of two (2) feet per second shall be provided in conjunction with closing speeds of 1.0 foot per second in accordance with governing code. Door operation shall be arranged to commence after the car enters its final leveling approach to a landing. In no case shall the door opening cycle conclude before the car comes to a complete stop at floor level with machine brake set.
2. When responding to either a car or corridor call, the amount of time that the elevator car door remains stationary in the open position shall be adjustable anywhere up to sixty (60) seconds. Door open dwell time for corridor calls shall be separate of that for car calls, and in both cases, dwell time shall be canceled whenever the doors are fully open and a car call is registered.
3. The new car operating station shall be provided with a "door open" and "door close" pushbutton. Pressure on the "door open" button shall cause the car door in the full open position to remain so and doors engaged in the close cycle to reverse direction and assume the full open position so long as pressure remains applied to the button. The "door close" pushbutton shall function on Independent Service, Attendant Service and Phase II – Emergency In-car Operation as well as during normal automatic operations.
4. Repeated attempts by the power car door operator mechanisms to open or close the car doors at any landing shall be monitored by the new microprocessor control system. In the event the doors should fail to cycle properly after a preset (adjustable) number of attempts, the car shall either travel to the next stop or remove itself from service, depending upon whether the malfunction is in the open or close cycle.
5. Car door shall be arranged so as to prevent it being manually opened from inside the car unless the elevator is positioned within a floor landing zone per A17.1 Standards.

E. Hoistway Access Operation (New)

1. Provision shall be made to allow access to the hoistway through the use of hoistway access switches.
2. Operating the access switch shall permit the car to be moved at slow speed (inspection speed) with the doors open to allow authorized persons to obtain access to the top of the elevator car.
3. Access operation must be code compliant and conform to the current A17.1 Code for elevators and escalators.

F. Fire Emergency Operation (New)

1. Phase I - Emergency Recall Operation shall be provided for each car in accordance ASME/ANSI A17.1 code as modified under the applicable local or State law.
2. Each main car operating station shall be provided with an indicator light and warning buzzer, each of which shall become activated whenever Phase I Operation is engaged. The warning buzzer shall cease to function once the car has completed the recall sequence and is positioned at the designated recall landing. The indicator light shall remain illuminated as long as Phase I Operation is activated.
3. A three-position, key-operated switch shall be provided on the designated recall landing to manually activate Phase I Operation. When activated, Phase I Operation shall be arranged so that in order to reset normal service, all cars must first be returned to the designated recall landing, after which the Phase I key-switch must be turned to the "OFF" position.
4. Phase II - Emergency Recall In-Car Operation shall be provided for each car in accordance with ASME A17.1 code as modified under local or State law.
5. Each main car operating station shall be equipped with a three-position, key-operated switch to engage Phase II Operation on elevators which have completed the Phase I recall sequence, and which are parked at the designated recall landing or alternate floor landing. Subsequent to activating Phase II Operation on any elevator, that elevator must be returned to the designated recall landing in order to discontinue that service mode.
6. Each main car operating station shall be provided with a "CALL CANCEL" pushbutton that functions only under Phase II operating mode. When activated, pressing the "CALL CANCEL" button shall cause any previously registered car calls to cancel per ASME standards.
7. Each main car operating station shall incorporate the National Standard fire logo and/or operating instructions, engraved and red color filled, as required by the applicable local or State law requirements.

G. Smoke Detector System (New)

1. The elevator contractor shall coordinate with the .4 Electrical Contractor to provide a complete smoke detector system for elevator recall to comply with the governing authority's requirements and ASME A17.1 as approved or modified under local law. The new system shall be configured as follows:
  - a. Smoke detectors shall be installed in the elevator lobby at each floor, top of hoistway, in pit areas and associated elevator machine room in accordance with NFPA No. 72A through 72E, Automatic Fire Detectors, Chapter 4. The activation of a smoke detector in any elevator lobby or associated elevator machine room other than the designated level (first floor) shall cause all cars in all groups that serve that lobby to return non-stop to the designated level (ground floor). If the smoke detector at the designated level (ground floor) is activated, the cars shall return to an alternate level (first floor) unless the Phase 1 key-operated switch is in the "firemen service" position. Smoke detectors and/or smoke detector system shall not be self-resetting.
  - b. Elevator recall system shall incorporate a minimum number of zones as follows:

- 1) Zone 1: Ground Floor.
- 2) Zone 2: Alternate Floor (first floor).
- 3) Zone 3: Machine Room.
- 4) Zone 4: Top of shaft way.
- 5) Zone 5: Pit.
- 6) Zone 6: Fire hat.
- 7) Zone 7: To all typical landings serviced.

- c. The smoke detectors required for elevator recall shall be part of the building fire alarm system upgrade. All additional programming needed to allow the "tie in" to occur shall be at the expense of the elevator contractor.
- d. Regarding Item c above, should any modifications to the existing fire alarm be required as part of the utilization of that system, the elevator contractor shall take full responsibility for its operation. Additionally, any cost associated with the above referenced work shall be included in the project pricing. No change orders shall be applicable under any circumstances.

#### H. Emergency Power Operation (New)

1. Provisions shall be included in all of the new elevator control systems whereby, immediately after transferring to the building emergency power system, all affected elevators shall automatically return to the main fire recall landing in progressive numerical sequence at normal operating speed. Car and corridor calls shall become inoperative, and all previously registered calls shall be canceled. As the car arrives at the designated landing, it shall park out of service with its door in the open position.
2. Upon completion of the recall process, one elevator shall respond as if it were in normal power mode (see Section 2.8 Fixtures for specific information regarding the panel). Upon power removal and normal power being restored to the building, a pre-initiation input to the elevator controller's computer shall cause the elevator to stop at the nearest available floor, if not already stopped, open its doors and wait for a power confirmation from a switch gear and the power with usable characteristics has been restored. The unit may then be allowed to go back into service.
3. An emergency power generator is present and in working order, including switch gear operation. The elevator contractor shall size, confirming all new loads to be acceptable for the new proposed elevator equipment, and provide all necessary connections and tie ins required to make the emergency generator functional and perform in a code compliant and acceptable manner.
4. The emergency power control panel shall have capacity to add two new 5,000 lb. MLR traction elevators to be added to the State Museum via future Phase 6.
5. Locate the emergency power control panel in Fire Command G-40A.

#### I. Independent Service Operation (New)

1. The car operating station shall be equipped with a key-operated switch labeled "INDEPENDENT SERVICE". When placed in the "on" position, this switch shall cause the elevator to bypass all corridor calls and to travel directly to any floor chosen by registration of a car call. During Independent Service Operation, the elevator doors shall remain open at any landing until the door close or car call registration pushbutton, is pressed and maintained until the doors are fully closed.
2. In case an elevator is operating on the Independent Service mode and the Fire Emergency Recall system becomes activated, following a period of approximately forty-five (45) seconds, the elevator shall automatically override Independent Service Operation and engage Phase I - Fire Emergency Recall Operation.
3. If more than one (1) car call is registered, all registered car calls shall extinguish when the elevator stops in response to the first call.

J. Load Weighing (New)

1. A positive means shall be provided to continuously monitor the amount of load being transported by the elevator car. The system shall be used to preload static motor drives, activate control features that include anti-nuisance operation, load dispatch operation, and load non-stop operation where applicable. The anti-nuisance feature shall operate at loads not exceeding 200 lbs., whereas load dispatch and load non-stop shall be set to function at 65% of the rated loading capacity for the initial set up and adjustment procedure.

K. Car Security Operating Controls (New)

1. Provide necessary software/hardware to operate security feature for all car calls and each floor push button for all landings served.
2. Arrange special key operated switch located in the COP (behind locked door) to override the security system functions.
3. Override security controls with fire emergency controls in accordance with code and local laws.
4. Provide all Security System Interface and Camera Control Wiring as necessary including "wire and terminations" to operate the above referenced control systems. Mounting the card readers and security cameras shall be the responsibility of the Security Contractor, however the elevator contractor shall allow access and supply assistance on an as needed basis free of additional charge should access be requested.
  - a. Provide necessary provisions (including software) for security service for each elevator and its associated interface between outside vendor (Security Company) and elevator system.
  - b. Provide and identify a manual override toggle switch on the exterior of the group or master controller that will remove all of the units from security mode. The switch must be identified by a permanent label with lettering at least three (3) inches tall and shall be accessible by building personal.
  - c. Power Supplies and incidentals required for the card readers and or security cameras shall be supplied by the security contractor. The elevator contractor shall supply the appropriate power source (120 VAC) to the vicinity in which the power source is required to operate the security contractor's equipment in an efficient and acceptable manner.
  - d. Should an interface box need to be utilized between the security contractor and elevator equipment the security company shall supply and mount the box in an acceptable location. The elevator contractor shall provide the appropriate pipe and wire to accomplish the required tasks and shall work together with the security contractor to terminate and make the appropriate connections as required in both the elevator controller and interface box.
  - e. Provide the required wiring for card reader access and camera controls to be included in the traveling cables. Before ordering the wire the elevator contractor shall confirm the type of wire required with the security company. Splicing of wire or wires will not be accepted.

L. Provide Fire Service interface provisions (New)

1. Provide to tie in and make operational fire emergency control interface provisions consisting of primary, alternate and flashing hat subject to activation by fire sensing devices (ref. NFPA 72E, Chapter 4) located in the elevator machine rooms, the hoistways, or in the elevator lobby on any landing other than the designated fire recall landing (Main Floor). The contacts shall be wired to an electrical junction box located inside each elevator machine room for connection to the elevator control systems by the Contractor. Each wire shall be clearly labeled with its control function.



## 2.3 MACHINE ROOM EQUIPMENT

### A. Control Equipment (New)

1. A new microprocessor-based elevator control system shall be provided. This equipment shall utilize digital logic to calculate optimum acceleration and deceleration patterns for the car to follow during each run. Closed-loop distance and velocity feedback shall be provided to monitor the degree to which actual performance of the elevator car conforms to the desired speed profile. Basic systems operating software shall be stored in non-volatile, electrically programmable read only memory (EPROM), whereas, field adjustable parameters shall be stored in an electrically erasable programmable read only memory (EEPROM).
2. Elevator control relays, contactors, switches, capacitors, resistors, fuses, circuit breakers, overload relays, power supplies, circuit boards, static motor drive units, wiring terminal blocks and related components shall be totally enclosed inside a free-standing metal cabinet with hinged access doors. Control equipment cabinets shall be provided with forced air ventilation to prevent overheating of the electrical components housed therein.
3. All electrical wiring inside the control equipment cabinet, whether done in the factory or at the job site, shall be performed in a neat, workmanlike manner. All field wiring shall terminate at stud blocks provided inside the control equipment cabinet for that purpose. Each wiring terminal shall be clearly identified according to the nomenclature used on the "as built" wiring diagrams. No more than two (2) field wires may be connected to any single terminal stud. Spare wires shall be tagged according to their point of termination, bundled, and neatly placed at the bottom of the control equipment cabinet.
4. Alphanumeric identification symbols shall be permanently affixed to each electrical component housed within the control equipment cabinet. These identification symbols shall be identical to those depicted on the "as built" wiring diagrams.
5. A 14" or larger CRT display monitor shall be provided inside the elevator machine room for diagnostic purposes. By means of graphic depiction, information available on the screen shall include:
  - a. An overview of car and corridor calls currently existing within the system.
  - b. Elevator operating status.
  - c. Elevator position, direction of travel and velocity.
  - d. The open/close status of elevator doors.
  - e. The current operational status of each CPU input and output.
  - f. A sequential history of faults detected within the control system over the previous thirty (30) days.
6. In case placement of new elevator control equipment cabinets inside the machine rooms should interfere with direct sight lines between the main line disconnect switch and rotating equipment belonging to the affected elevator, an auxiliary locking disconnect switch shall be provided. The mounting location of this auxiliary disconnect switch shall be chosen so as to provide clear sight of the associated rotating equipment.

### B. Worm Geared Traction Machines (New – with New AC Motor)

1. Machine Beams (Existing)
  - a. Provide additional support beams, angles, plates, bearing plates, blocking steel members, etc., to support new machine, governors, dead end hitches, deflector and overhead sheaves from existing machine beams if applicable. Contractor is required to verify adequacy of existing machine support and report any inadequacies via an RFI in eBuilder.
2. Geared Traction Machine and Deflector Sheave (New)

- a. Provide a new worm-gear traction machine with motor, DC brake and demountable drive sheave, mounted in proper alignment on a common bedplate. The worm shall be accurately machined from steel and provided with a single end, double race ball bearing thrust. The worm gear shall be made from a phosphor bronze rim, accurately cut, fitted and bolted to a cast iron spider. The drive sheave shall be a demountable casting from the best grade of metal with a Brinell hardness of 215 to 230, and shall be machined with grooves, providing maximum traction with a minimum of cable and sheave wear. Provide means for lubricating the machine. The gear housing shall have a gasketed hole to inspect the gear.
- b. Provide machine with an electro-mechanical brake. The brake shall be spring applied and electrically released. Swivel type brake shoes shall be applied to the braking surface simultaneously and with equal pressure by means of helical compression springs. Design the brake electro-magnet for quick release to provide smooth and gradual application of brake shoes.
- c. Span the distance between the car and counterweight with an accurately grooved new deflector sheave. Mount the new deflector sheave to the bedplate in the machine room. Provide sheave guards to prevent ropes from jumping off grooves and to prevent possible entrapment on both sides of the floor penetrations.
- d. Provide sound reducing vibration isolation elements at all support points of the elevator hoisting motors and machines. Elements between the hoisting machine (unitized base) and machine support beams shall be similar to triple (3) layer ribbed neoprene pads, separated by appropriate steel shims as manufactured by Mason Industries, Type W pads, at 50 durometers, loaded for 40 psi. All bolts through isolation elements, where necessary, are to incorporate resilient washers and bushings.
- e. Provide hoist cable guards at the car and counterweight drop side of the hoisting machine sheave to prevent accidental contact with the hoisting cables. The guard shall extend from the point where the hoisting cables penetrate the machine room floor slab to a point beyond where the cables contact the traction and new deflector sheaves. The guards shall also be constructed so as to conceal pinch-points between cables and sheave grooves.

### 3. Machine Brake (New)

- a. Provide the hoisting machine with a spring applied and electrically released electromechanical brake. Swivel type brake shoes shall be applied to the braking surface simultaneously and with equal pressure by means of helical compression springs. Design brake electromagnet for quick release to provide smooth and gradual application of the brake shoes.
- b. Brakes shall be designed and adjusted to safely hold 125% of rated full load capacity in accordance with applicable code.

### 4. AC Drive Motor (New)

- a. Provide a new variable speed, reversible alternating current induction motor with high starting torque and low starting current, rated for 50° C (122° F) during continuous operation, designed for this particular elevator application.
  - 1) Ensure that adequate ventilation of internal stator windings and rotating element is provided to prevent overheating with thermal overload protection.

- b. The new hoist motor housing shall have a rigid cast iron stator frame for maximum strength and rigidity. Core Plate stator laminations shall be press fit into frame and properly secured. Stator windings shall be insulated with Mylar Paper laminate, formed and fit to core.
- c. New rotating element shall be fabricated from drawn bars machined and fitted in slots with end rings brazed together. Complete rotating element shall be dynamically balanced for vibration-free operation.
- d. Motor shaft shall be manufactured from carbon hot rolled steel for maximum strength.
- e. Properly align new hoisting motor and make all necessary electrical connections to the control circuitry.

C. VVVF AC Drive (New)

- 1. A solid-state, variable voltage, variable frequency (VVVF), 3-phase AC hoist motor drive system shall be provided as an integral part of the new microprocessor-based equipment. The primary component of this VVVF drive system shall be a low-noise, flux-vector inverter device, featuring a digital LED readout and touch-key pad, designed to facilitate software parameter adjustments, monitor systems' operation and display fault codes.
- 2. In addition to an inverter, the VVVF drive unit shall consist of a separate dynamic braking module to reduce hoist motor deceleration time, a resistor bank to absorb power regenerated by the hoist motor, and a HP rated 3-phase AC contactor with overload protection to disconnect the inverter from the hoist motor whenever the elevator is stopped.
- 3. The system shall be designed and configured with countermeasures for noise generated by the pulse-width modulated (PWM) inverters. Countermeasures shall include but are not limited to, control of radiated noise via inverter and/or motor cables, conducted noise through power lines, induction noise and ground noise.
  - a. Inverter device shall be encased in metal and properly grounded independently.
  - b. A noise filter for the input power line shall be provided to prevent penetration into radios, wireless equipment and detectors.
  - c. Provide interconnection wiring and ground cables in accordance with the manufacturer's design requirements.

D. Governor (New)

- 1. Provide a speed governor, located overhead, to operate the car safety.
  - a. Maintain the proper tension in the governor rope with a weighted tension sheave located in the pit. Springs used to develop the tension are not acceptable.
  - b. Provide rope grip jaws, designed to clamp the governor rope to actuate the car safety upon a predetermined overspeed downward. Rope grip jaws directly coupled to the governor mechanism so as to float with governor movement shall not be permitted.
  - c. Centrifugal type governors shall trip and set rope jaws within 60 degrees of governor sheave rotation after reaching rated tripping speed.
  - d. Design the governor rope-tripping device so that no appreciable damage to or deformation of the governor rope shall result from the stopping action of the device in operating the car safety.
  - e. Provide an electrical governor overspeed protective device which, when operated, shall remove power from the driving machine motor and brake before or at the application of the safety. The setting for the overspeed switches shall be as prescribed in the ASME A17.1 Code.

- 1) Locate and enclose the switch to ensure that excess lubrication will not enter the switch enclosure.
- 2) Overspeed switches shall operate in both direction of travel on systems employing static power drive units.

f. Seal and tag the governor with the running speed, tripping speed and date last tested.

E. Equipment Isolation (New)

1. Provide sound reducing vibration isolation elements at all support points of elevator controller, solid-state motor drives, isolation transformers, hoisting motors and machines. The elements for controllers, solid-state motor drives and isolation transformers shall be similar to double deflection neoprene-in-shear mounts, as manufactured by Mason Industries, Type ND, with 0.35" static deflection under design load ratings. Elements between the hoisting machine (unitized base) and machine support beams shall be similar to triple (3) layer ribbed neoprene pads, separated by appropriate steel shims as manufactured by Mason Industries, Type W pads, at 50 durometers, loaded for 40 psi. All bolts through isolation elements, where necessary, are to incorporate resilient washers and bushings.

F. Deflector and Idler Sheaves (New)

1. Provide new overhead and/or machine room wire rope cable deflector sheaves with related apparatus and structural mounting supports.
2. Locate and size new sheaves to maximize use of available clearances maintaining the present car and counterweight hitch drops.
3. New support bearings shall be of a roller type designed for a minimum of twice the total load calculation equipped with pressure activated or other suitable lubrication devices.
4. Required mounting beams and structural supports shall be interfaced with existing building structures modified under the terms of this contract for the new design rated and located loading.
5. Provide sheave guards for all apparatus and secure same to supporting building elements.

G. Ascending Car Overspeed Protection Device (New)

1. Provide a device designed to prevent an ascending elevator from striking the hoistway overhead structure.
2. The device shall decelerate the car with any load up to the rated capacity by applying an emergency brake.
  - a. The device shall detect an ascending car overspeed condition of not greater than 10% higher than the speed that the car governor is set to trip.
  - b. The device, when activated, shall prevent operation of the car until the device is manually reset.
  - c. The device shall meet the requirements of the ASME A17.1 Safety Code as may be modified by the Authority Having Jurisdiction.

H. Unintended Car Movement Protection Device (New)

1. Provide a device to prevent unintended car movement away from the landing when the car and hoistway doors are not in the closed and locked.
  - a. The device shall prevent such movement in the event of failure of:

- 1) The electric driving machine motor
  - 2) The brake
  - 3) The machine shaft or shaft coupling
  - 4) Gearing
  - 5) Control system
  - 6) Any component upon which the speed of the car depends
  - 7) Suspension ropes and the drive sheave of the traction machine are excluded.
- b. The device shall prevent operation of the car until the device is manually reset.
- c. The device shall meet the requirements of the ASME A17.1 Safety Code as may be modified by the Authority Having Jurisdiction.

## 2.4 HOISTWAY APPARATUS

### A. Car and Counterweight Guide Rail Systems (Reuse)

1. Car and counterweight guide rails, fish plates, rail brackets, backing support and related attachments shall be inspected to determine if unfavorable conditions exist that diminish the structural integrity of any component. In the event substandard conditions are disclosed by means of this inspection, the Contractor shall immediately inform the Department and the Professional as to the exact nature of said problems and then undertake whatever repairs and/or replacements the Professional may deem appropriate to remedy the situation.
2. Each stack of car and counterweight guide rails shall be individually examined to determine if excessive compression has occurred from building settlement. In the event such conditions are found to exist, each affected stack shall be cut off enough to relieve pressure. Jacking bolts shall be provided underneath each stack of both car and counterweight guide rails.
3. Each stack of car and counterweight guide rails shall be realigned so that total deviation from plumb in any direction does not exceed 1/8" over the entire length of the hoistway and that DBG measurements never vary more than .030".
4. As required, car guide rails joints shall be individually filled, filed and sanded in order to eliminate minor variations in adjoining machined surfaces.
5. Apart from the guide rail systems' reconditioning work specified herein, the Contractor shall perform whatever additional work may be required so that side-to-side and front-to-back acceleration of the elevator car traveling at full rated speed in either direction over the entire length of the hoistway with loads varying from empty car to full rated load never exceeds 18 milli-g peak to peak.

### B. Counterweight Assembly (Reuse)

1. The existing counterweight assembly shall be refurbished to as new condition and reused. Individual counterweight frame members shall be inspected for any indication of damage and to determine if the overall assembly is twisted, racked, or otherwise distorted. In case any of these conditions are found to exist, the Contractor shall immediately inform the Department and the Professional about the exact nature of the problem and undertake whatever corrective action the Professional may deem appropriate to remedy the situation. All fastenings between counterweight frame members shall be individually examined, tightened and if necessary renewed.
2. The amount of filler weight placed within the counterweight frame shall be adjusted so the weight of the entire counterweight assembly is equal to that of the renovated elevator car, plus 40-50% of its rated loading capacity. Filler weights shall be held securely in place at all times with tie rods passing through holes in both the weights and the counterweight frame. Tie rods shall be secured on each end with double lock nut and a cotter pin arrangement.

- C. Roller Guides (New) (Car & Counterweight)
1. Provide rubber tired, spring loaded, adjustable roller guides top and bottom of the car and counterweight frames for all elevators.
  2. Design three-wheel roller guides to run on unlubricated guides and equip them with 16-gauge cover guards.
- D. Hoist Cables and Governor Cables (New)
1. Existing wire rope hoisting and governor cables shall be removed and replaced with new.
    - a. Hoisting Cables - New pre-formed traction steel wire ropes, specifically constructed for elevator applications, shall be provided for suspension of the elevator car and counterweight assembly. New hoist cables shall be identical in number and construction to those which are currently in use.
    - b. Governor Cables - New pre-formed traction steel wire ropes, specifically constructed for elevator applications, shall be provided for governor cables. Governor cables shall be arranged so as to pass over top of the governor sheave in the machine room and underneath the tail-end sheave located in the pit. Both ends of the governor cable shall be attached to the safety release carrier. Governor cable diameter and method of fastening shall be in accordance with Section 206 of ASME A17.1 elevator safety code.
  2. Hoist cable fastenings shall be accomplished by use of individual tapered rope sockets or wedge type with adjustable shackles. General design requirements for cable shackles and the method of securing wire rope shall conform to ASME A17.1 elevator safety code.
  3. Broken hoist cable shackle springs shall be replaced on an as-needed basis.
- E. Normal and Final Terminal Stopping Devices (New)
1. Provide normal terminal stopping devices to stop the car automatically from any speed obtained under normal operation within the top and bottom overtravel, independent of the operating devices, final terminal stopping device and the buffers.
  2. Provide final terminal stopping devices to stop the car and counterweight automatically from the speed specified within the top clearance and bottom overtravel.
  3. The terminal stopping devices shall have rollers with rubber or other approved composition tread to provide silent operation when actuated by the fixed cam in the hoistway.
- F. Electrical Conduit, Wiring and Traveling Cable (New)
1. New rigidly supported EMT conduit, flexible metal conduit and galvanized steel trough shall be utilized throughout the hoistway.
    - a. Both EMT and flexible conduit shall be connected on either end by use of compression fittings and secured in place with metal clamps sized in accordance with the diameter of conduit utilized. Wire or plastic wire ty-raps shall not constitute an acceptable means of fastening.
    - b. The use of flexible metal conduit shall be limited to runs not greater than 3' in length.
    - c. All abandoned or unused electrical conduit shall be removed from the hoistway.
  2. New electrical wiring shall be provided. All wiring shall be stranded copper conductors, manufactured in compliance with ANSI/ASTM B174-71 and UL 62 requirements, and polyvinyl chloride insulation complying with ETT requirements of UL 62 and Article 400 of the National Electric Code.

3. Electrical wiring provided for hoistway interlocks shall be of a flame-retardant type, capable of withstanding temperatures of at least 392 degrees Fahrenheit. Conductors shall be Type SF or the equivalent thereof.
  - a. Each run of electrical conduit or duct shall contain no less than 10% spare wires and, in any case, no fewer than five (5) spare wire.
  - b. Crimp-on type wire terminals shall be used where possible.
4. New traveling cables shall be provided. Each traveling cable shall be provided with a flame- and water-resistant polyvinyl chloride jacket. Electrical wiring shall consist of stranded copper conductors, manufactured in compliance with ANSI/ASTM B174-71 and UL 62 requirements, and polyvinyl chloride insulation complying with ETT requirements of UL 62 and Article 400 of the National Electric Code.

Each traveling cable shall contain no less than 10% spare wires.

- a. Traveling cables exceeding 100' in length shall be provided with a steel wire rope support strand from which the cable shall be suspended.
- b. Traveling cables must be contained within an approved electrical conduit to within 6' of the final suspension point in the hoistway.
- c. Each new traveling cable shall be arranged to provide no fewer than six (6) individually shielded pairs of 22-gauge wire and arranged to contain no less than one (1) coaxial cable for CCTV remote monitoring, and the required quantity of CAT 6 cables for the communication system.
- d. Traveling cable conductors that terminate at a hoistway center box shall be connected to stud block provided for that purpose. Each wiring terminal shall be clearly identified by its nomenclature as shown on the "as built" wiring diagrams and solderless, crimp-on type wire terminals shall be used where possible.
- e. The attachment of a traveling cable to the underside of the elevator car shall be performed so that a minimum loop diameter of 30x the cable diameter is provided.

#### G. Hoistway Projections and Setbacks

1. The top surface of any setback or projection in the hoistway that measures 2" or more in width shall be beveled at an angle of not less than 75 degrees from horizontal. Each bevel plate shall be constructed from prime painted 14 gauge cold-rolled steel and installed so as to conform to Rule 100.6 of ASME A17.1 elevator safety code.

## 2.5 PIT APPARATUS

### A. Existing Car and Counterweight Buffers (Reuse)

1. The present spring buffers shall be reused in place. All springs, supports and related equipment shall be checked to assure it conforms to governing Codes. If repair or replacement of components is required, they shall be included under this specification. In case problems are found to exist, the Contractor shall immediately inform the Department and the Professional and then undertake whatever repairs and/or replacements the Professional may deem appropriate to remedy the situation. Surface rust shall be removed from all reused components.
2. Upon substantial completion of all work described in the project specifications, buffers shall undergo testing in accordance with ASME A17.1 Code.

### B. Governor Cable Tension Assembly (New)

1. Provide a new governor cable tension assembly.
  - a. Maintain the proper tension in the governor rope with a weighted tension sheave located in the pit. Springs used to develop the tension are not acceptable.
  - b. The sheave shall be of proper diameter and set directly plumb with the governor cable drop to prevent the cable from pulling off of the sheave at an angle.
  - c. Lubrication fittings shall be provided on the assembly.
  - d. The assembly shall have necessary cable guards to prevent accidental contact of the cable/sheave by service personnel. Guards shall also be provided to prevent the governor cable from jumping off of the sheave.

C. Pit Stop Switch (New)

1. As pit depth exceeds 66", each elevator pit shall be provided with two (2) push/pull or toggle switches that are conspicuously designated "EMERGENCY STOP". Both of these stop switches, shall be located immediately adjacent to the pit access ladder. One of the stop switches shall be placed approximately 48" above the pit floor while the other stop switch shall be positioned approximately 18" above the hoistway entrance sill on the lowest landing served. These switches shall be arranged so as to prevent the application of power to the hoist motor or machine brake when either one is placed in the "off" position.

## 2.6 HOISTWAY ENTRANCES

A. Hoistway Entrances (Reuse)

1. Hoistway entrance sills, sill supports, entrance frames, headers, header supports, and door panels shall be reused and refurbished.
  - a. Hoistway entrances that have become distorted or bent shall be straightened, plumbed, reset to the proper width dimension and reinforced as necessary.
  - b. Provide each existing door panel with two new removable laminated plastic composition guides, arranged to run in existing sill grooves with a minimum clearance. The guide mounting shall permit their replacement without removing the door from the hangers. A steel fire stop shall be enclosed in each guide.
  - c. Provide the meeting edge of center opening doors with new low profile continuous rubber astragal bumper strips. These strips shall be relatively inconspicuous when the doors are closed. Also, provide rubber bumpers at the top and bottom of each section of door to stop them at their limit of travel in the opening direction.
  - d. Provide necessary new fascias. 14-gauge steel fascia plates shall extend at least the full width of the door and be secured at hanger support and sill with oval head machine screws. Reinforce fascia to allow not more than 1/2" of deflection.
  - e. Provide fascia plates where the clearance between the edge of the loading side of the platform and the inside face of the hoistway enclosure exceeds the code allowed clearance.
  - f. Provide necessary new toe guards - Provide 14-gauge steel toe guards to extend 12" below any sill not protected by fascia. The toe guards shall extend the full width of the door and shall return to the hoistway wall at a 15-degree angle and be firmly fastened. They should be in accordance with current code.
  - g. Remove oil, dirt and impurities on new and existing apparatus and give a factory coat of rust inhibitive paint to all exposed surfaces of struts, hanger supports, covers, fascias, toe guards, dust covers and other ferrous metal.



- h. Remove and patch existing access holes (escutcheon) at each landing. Provide to cover existing holes (hoistway side only) in door panels as necessary to retain any sound deadening materials that may be present in the door panels. Repaint hoistway doors to match existing colors. Provide new escutcheon access with approved barrel inserts as per applicable code.
- i. Provide new non-vision wings (sight guards) the full length of the hoistway doors and paint them black.
- j. Provide new braille marking plates at each entrance frame. Remove existing braille plates and replace at the code dictated height.
- k. Provide proper support under all hoistway sills. Un-grouted or incorrectly supported sill shall be re-supported in an approved manner.
- l. Provide new hoistway entrance sills of the same materials as existing if they are bent or distorted beyond repair.
- m. Clean all sills "car and hoistway" to a new like condition. If either are bent or distorted in any way they shall be replaced with new that matches the existing finishes.
- n. Prep and paint hoistway frames and doors. Refer to Specification Section 099600 "High Performance Coatings."

B. Landing Door Tracks, Hangers, Closers, Interlocks and Related Appurtenances (New)

- 1. Formed or extruded steel landing door hanger tracks as manufactured by G.A.L. Corporation or an approved equal shall be provided. closures
- 2. Each landing door panel shall be suspended from a pair of new door hanger assemblies that are compatible with the new hanger tracks. Hanger assemblies shall be directly mounted to the door panel using 3/8" diameter or better hardware. In the event the job-site condition dictates the use of spacers between hanger assemblies and the landing door panel, solid steel blocks shall be provided for that purpose. Jacking bolts or G.A.L. manufactured "U" shaped spacers are not acceptable for this application. Hanger assemblies shall be adjusted or shimmed so that door panels are suspended in a plumb manner with no more than 3/8" vertical clearance to the cab entrance threshold. Upthrust rollers shall be adjusted for minimal operating clearance against the bottom edge of the hanger track.
- 3. Each set of multi-speed or single speed side slide doors shall be provided with a new sill-mounted type CL-5 spring closing/relating mechanism as manufactured by G.A.L. Corporation or an approved equal.
- 4. Each set of landing doors shall be provided with a complete new Type "MO" electromechanical interlock assembly for side sliding equipment as manufactured by G.A.L. Corp. or an approved equal. Each interlock assembly shall consist of a switch housing with contacts, lock keeper, clutch engagement/release subassembly, and all associated linkages.
- 5. Non-typical mounting arrangements for interlocks and/or related mechanisms must receive prior approval from the Professional.
- 6. Each hoistway door interlock assembly shall be provided with an emergency release mechanism utilizing a drop-leaf type access key at all landings served.

C. Hoistway Door Hangers, Sheaves and Tracks (New)

- 1. Provide a sheave type two-point suspension hanger and track for each hoistway door. Sheaves shall be hardened steel, not less than 3 1/4 inches in diameter with sealed grease-packed precision ball bearing.
- 2. The upthrust shall be taken by a roller mounted on the hanger and arranged to ride on the underside of the track.
- 3. The track shall be of formed cold rolled steel or cold drawn steel and shall be rounded on the track surface to receive the hanger sheaves. The track shall be removable and shall not be integral with the header.

D. Interlocks, Contacts and Unlocking Devices (New)

1. Equip each elevator hoistway door with a positive interlock which shall prevent the operation of the elevator unless all elevator doors are closed and maintained closed when elevator is away from the landing. The interlocks shall also prevent the opening of a hoistway door from the landing side unless the car is within the landing zone and is either stopped or being stopped at that level. Retiring cams used to actuate interlock shall be securely fastened to car construction and shall be designed to operate without objectionable noise, shock or jar. Design interlocks so that they are not easily accessible from the landing side.

E. Hoistway Side Slide Type Hoistway Doors (Existing)

1. Reuse existing hoistway doors. Provide all new hardware per this specification section.
2. Prep and paint door panels. Refer to Specification Section 099600 "High Performance Coatings."

2.7 CAR APPARATUS/FRAME

A. Car Frame (Reuse)

1. The existing car frame assembly shall be refurbished to as-new condition and reused. Individual car frame members, platform isolation framework, door operator support structure, related bracing and appurtenances shall be inspected for any indication of damage and to determine if the overall assembly is twisted, racked or otherwise distorted. In case any of these conditions are found to exist, the Contractor shall immediately inform the Professional and then undertake whatever corrective action the Professional may deem appropriate to remedy the situation. All fastening between the aforementioned components shall be individually examined, tightened and if necessary renewed.
  - a. Provide new elastomer isolation pads for all existing platforms.
2. The existing car frame, door operator support structure and related bracing shall be modified or reconfigured as necessary in order to accommodate the new cab enclosure and/or related master door operating equipment specified herein.
3. The elevator car shall undergo static balancing upon substantial completion of all work described in the project specifications and subsequent to any car interior refinishing or cab replacement work performed in conjunction with the project.

B. Platform (Reuse)

1. Existing platform shall be modified to accommodate the new apparatus specified herein.
  - a. Underside of platform shall be refurbished and treated with fire-rated material.
  - b. Top of platform shall be refurbished with marine grade plywood set to receive new finished floor covering. Refer to Specification Section 096519 "Resilient Tile Flooring."
  - c. Provide a new safety access "hole ring and cover assembly" to match selected cab finishes.

C. Safety (Reuse)

1. The existing governor actuated car safety device shall be retained, overhauled and upgraded for current code compliance.
2. Readjust safety for proper operation in accordance with current ASME A17. design standards.
3. Check the existing safety-operated switch (plank-switch) for proper adjustment and operation. Provide a new plank-switch where none currently exists.
4. Provide and check the existing safety release tool for proper adjustment and operation. Mount the releasing tool in the machine room in plain sight on the machine room wall. Provide a label above the tool stating that it shall not be removed from the machine room.

D. Automatic Leveling/Releveling Device (New)

1. Equip the elevator with a floor-leveling device which shall automatically bring the car to a stop within 1/4" of floor with any floor for which a stop has been initiated regardless of load or direction of travel. This device shall also provide for releveling which shall be arranged to automatically return the elevator to the floor in the event the elevator should move below or above floor level in excess of 1/4".
2. The leveling device may be separate from, or an integral part of the hoistway encoding and positioning system.

E. Master Door Operating System (New)

1. Furnish and install a new heavy-duty master electric power door operator on the elevator car. Design this operator to operate the car and hoistway door simultaneously. (GAL manufactured type "MOVFR" or approved equal).
  - a. Designate this type of operator as a high-speed operator. Design the door panels to operate at an average opening speed of 2.0 feet per second. Automatic closing of the car and hoistway doors shall be required and the closing speed shall be approximately 1 foot per second. Reduce this closing speed as required to limit the kinetic energy of the closing doors to the values permitted by the ASME Code.
  - b. The doors shall operate smoothly without a slam in both the opening and closing directions. Cushion the doors in their final movement in both directions of travel by electrical means (dynamic braking) only. Air dashpots or hydraulic dampening will not be accepted. Use electrical power to open and close the doors.
  - c. In case of interruption or failure of electric power from any cause, the door operating mechanism shall be so designed that it shall instantly permit emergency manual operation of both the car door and the hoistway door, and the hoistway door shall continue during emergency operation to be self-locking, and self-closing. The door operator shall operate in conjunction with or be equipped with all interlocks and safety contacts specified.
  - d. Construct all door operating levers of heavy steel members. All pivot points shall have either ball or roller bearings, or bronze bushings, of ample size. All brackets and other supports required to support door operating mechanism shall be furnished and installed.
  - e. Provide all new attachments, arms, clutch and related hardware as well as zone-lock devices as required by applicable local codes and ASME A17.1 standards.

F. Car Doors and Car Sill (New)

1. Provide standard 1" to 1.1/4" thick, 14-gauge hollow metal flush construction panels, reinforced for power operation and insulated for sound deadening.

2. Paint the hoistway side of each panel black and face the cab side with 14-gauge stainless steel.
3. The panels shall have no binder angles and welds shall be continuous, ground and invisible.
4. Drill and reinforce panels for installation of door operator hardware, door protective device, door gibs, etc.
  - a. Provide each door panel with two removable laminated plastic composition guides, arranged to run in the sill grooves with minimum clearance.
  - b. The guide mounting shall permit their replacement without removing the door from the hangers.
5. Provide the meeting edge of center opening doors with new low-profile rubber astragal bumper strips.
6. Provide a new car sill that matches the interior of the existing cab finishes. Secure the car sill in an appropriate manner as to provide an acceptable base and support so as not to allow the sill to cave in or otherwise allow deformation.

G. Car Door Hangers, Sheaves, Tracks and Door Clutch (New)

1. Provide a sheave type two-point suspension hanger and track for each car door. Sheaves shall be hardened steel, not less than 3 1/4 inches in diameter with sealed grease packed precision ball bearing.
2. The upthrust shall be taken by a roller mounted on the hanger and arranged to ride on the underside of the track.
3. The track shall be of formed cold rolled steel or cold drawn steel and shall be rounded on the track surface to receive the hanger sheaves. The track shall be removable and shall not be integral with the header.
4. Provide a new gate switch that connects directly to the car door track. The gate switch shall prevent movement of the elevator until such time as it signals the control equipment that the car door has physically closed.
5. Install a new car gate switch and adjust the switch to be code compliant.
6. Install a new door clutch to operate with the new door equipment.

H. Door Reopening Device (New)

1. Provide an infrared curtain door protection system.
2. The doors shall be prevented from closing from an open position if a person interrupts any one of the light rays. When the doors are closing, any interruption of the protective light field shall cause both the car and corridor doors to reverse. The doors shall start to close when the protection system is free of any obstruction.
3. The infrared curtain protective system shall have:
  - a. Height of protective field not less than 71" above the sill.
  - b. Where a horizontal infrared light beam system is used:
    - A minimum of 47 light beams.
    - Accurately positioned infrared lights to conform to the requirements of the applicable handicapped code.
  - c. Modular design to permit on board test operation and replacement of all circuit boards without removing the complete unit.
  - d. Controls to shut down the elevator when the unit fails to operate properly.

I. Top-of-Car Operating Station (New)

1. A new operating station shall be provided on top of the elevator car. This station shall be installed so that the controls are plainly visible and readily accessible from the hoistway entrance without stepping on the car.
2. The new top-of-car operating station shall be provided with the following control devices and appurtenances:
  - a. A push/pull or toggle switch designated "EMERGENCY STOP" shall be arranged so as to prevent the application of power to the hoist motor or machine brake when in the "off" position.
  - b. A toggle switch designated "INSPECTION" to activate the top of car Inspection Service Operation.
  - c. Pushbutton designated "Up", "Down" and "Safe" to operate the elevator on Inspection Service (the "Safe" button shall be arranged to operate in conjunction with either the "Up" or "Down" button).
  - d. An indicator light and warning buzzer that are subject to activation under Phase I - Fire Emergency Recall Operation.

J. Car Enclosure Work Lights and Receptacles (New)

1. The top and bottom of each car shall be provided with a permanent lighting fixture and 110-volt receptacle. Light control switches shall be located for easy accessibility from the hoistway entrance. Where sufficient overhead clearance exists, the car top lighting fixture shall be extended no less than 24" above the crosshead member of the car frame. Light bulbs shall be guarded so as to prevent breakage or accidental contact.

K. Emergency Exit (Top)

1. Ensure they operate as per code and provide or have proper electrical contacts and mechanical locks on the exterior of the cab enclosure.
2. Should side exits exist they shall be securely bolted shut so that they cannot be used in accordance with applicable code.
3. Provide additional support to the emergency exit hatch that will prevent it from giving way and falling into the elevator cab.

L. Car Door Zone Lock Restrictor (New)

1. Provide a car door zone lock restrictor.
2. In case of interruption or failure of electric power from any cause, the door operating mechanism shall permit emergency manual operation of both the car door and the hoistway door within the floor landing zone.
  - a. The hoistway door shall continue to be self-locking and self-closing.
  - b. The door operator shall operate in conjunction with or be equipped with all gate switches and safety contacts required by ASME A17.1 Code.
  - c. Provide zone-lock devices as required by applicable local codes and ASME A17.1

## 2.8 FIXTURES (NEW)

### A. Main Car Operating Panels (New)

1. Provide main and auxiliary car operating pushbutton panels on the inside front return panel of the car. The main panel shall be mounted on the right side while standing inside the cab looking into the hallway.
2. The pushbuttons provided for each floor served shall cause the car to travel to the floor on momentary pressure of the button.
3. The pushbuttons shall become individually illuminated as they are pressed. The button lights shall be extinguished as the calls are answered. LED-type bulbs are required to be utilized on all fixtures.
4. The operating panel shall include:
  - a. A call button for each floor served.
  - b. "Door open" / "Door close" buttons.
  - c. "Alarm" button (Interfaced with emergency alarm).
  - d. "Emergency Stop" switch per local law.
  - e. Hardwired hands-free communication system with call acknowledging feature and A.D.A. design provisions for direct communication to the Capitol Police Command Center (IMCS) in the East Wing of the Capitol.
  - f. Three (3) position firefighter key operated switch, call cancel button and illuminated visual/audible signal system with mandated signage engraved per ASME Standards and/or local law requirements.
  - g. Provide a locked service cabinet flush mounted and containing the keyswitches required to operate and maintain the elevator, including, but not limited to:
    - 1) Independent service switch
    - 2) Light switch.
    - 3) Multiple speed fan switch.
    - 4) G. F. I. duplex receptacle.
    - 5) Emergency light test button and indicator.
    - 6) Inspection Service Operation key switch.
    - 7) Inspection Service Operation key switch.
    - 8) Security override Operation keyed switch. (The keyed switch shall be cut differently than all other switches and provide the standard on/off type function.)
  - h. Car operating panel shall be flush mounted with swing type, one-piece faceplate with heavy-duty concealed hinges.
  - i. The auxiliary operating panel shall provide space for a card reader unit to be mounted behind a plexiglass panel centrally located within easy access for ADA accessibility the riding public.
  - j. Car operating panel shall incorporate a red digital LED floor position indicator, emergency light lens unit and black-filled engraved unit I.D. number or other nomenclature, as approved by the Professional, with a "No Smoking" advisory and the rated passenger load capacity.
  - k. Provide the Car operating panel "full length design" as to cover all pre-existing cutouts or blemishes.
  - l. The certificate frame shall be incorporated into and made part of the fixture.

- B. Car Position Indicator (New) (Incorporate into Car operating panels)
1. The position of the car in the hoistway shall be indicated by the illumination of the position indicator numeral corresponding to the floor at which the car has stopped or is passing.
  2. Provide 2" high, 10-segment red LED type position indicator with direction arrows, integral with the car operating panel.
    - a. Provide Lexan cover lens with hidden support frame behind fixture plate to protect the indicator readout,
    - b. Provide audible floor passing signal per ADA standards.
- C. Voice Annunciator (New)
1. Provide a voice annunciator in each elevator. Coordinate size, shape and design with Designer and other trades. The system shall include, but not limited to:
    - a. Solid state digital speech annunciator.
    - b. A recording feature for customized messages.
    - c. Playback option.
    - d. Built-in voice amplifier.
    - e. Master volume control located and identified for easy access.
    - f. Audible indication for selected floor, floor status or position, direction of travel and nudging.
  2. Locate all associated equipment in a single, clearly labeled enclosure located either in the machine room and/or on car top or COB station.
- D. Traveling Lanterns Car Direction Lantern (New)
1. Provide a traveling lantern with visual and audible signal in the edge of the return post. The lens shall project a minimum of 1/4" and shall be of solid plexiglass. Use tamperproof screws and mount stainless steel faceplate flush with hairline joint.
  2. Car lantern shall indicate the direction of travel when doors are 3/4 open.
  3. The unit shall sound once for the "up" direction and twice for the "down" direction.
- E. Surface-Mounted Corridor Push Button Stations (New)
1. Provide new corridor push buttons as further described:
    - a. Provide two risers of new surface-mounted push button signal fixtures with faceplates per the drawings at each landing. Each new signal fixture shall consist of a illuminating push buttons measuring 3/4" at their smallest dimension as selected by the Professional. New signal fixtures shall be installed directly over top of recessed mounting utilized by the existing corridor fixtures and shall be positioned so as to achieve a centerline button height of 42" above the floor. New signal fixture faceplates shall be installed both plumb and flush to the finished wall.
    - b. Each intermediate landing shall be provided with signal fixtures containing two (2) push buttons while terminal landings shall be provided with fixtures containing a single push button. These buttons shall be arranged to become illuminated on an individual basis as "up" or "down" calls are registered and shall remain so until canceled.
    - c. Provide engraving or laser etching of each cover plate with fire logo as indicated on the drawings.
- F. Cab Emergency Lighting (New) (Incorporate into each Car operating panel)

1. Provide an emergency lighting system to power an emergency lighting fixture and associated components incorporated in the car for at least four (4) hours in accordance with ANSI A17.1 code requirement.
2. Provide nickel cadmium batteries and a charger and mount the power pack on top of car.
3. Arrange for completely automatic operation when normal power is interrupted.
4. Provide a test button and indicator light in the car station.
5. Incorporate lighting lens unit within car operating panel (flush mounted).

G. Cab Enclosure Fan (New)

1. Provide a new exhaust type two-speed fan unit with cover grill, mounting accessories and necessary cab enclosure modifications.
2. New fan unit shall include self-lubricating motor with housing rubber mounted for sound vibration isolation.
3. Provide a multi-speed keyswitch in the elevator cab enclosure for control of fan unit.
4. Provide necessary new wiring and approved conduit to properly connect fan unit with power source and control keyswitch.

H. Fixture Attachment, Finish and Design

1. Graphics shall be as indicated on the drawings and as selected by the Professional.
2. The faceplates shall be stainless steel 1/8" thick minimum.
  - a. No. 4 directional finish.
3. Mount fixtures with tamperproof screws. The screw and keyswitch cylinder finishes shall match faceplate finish.
4. Where key-operated switches and/or key-operated cylinder locks are furnished in conjunction with any component of the installation, keys for each individual switch or lock shall be furnished, stamped or permanently tagged to indicate function.

2.9 SPECIAL REQUIREMENTS - ADA

A. Handicapped Requirements (ADAAG)

1. Locate door-reopening devices at 5" and 29" above the finish floor when individual contact projection apparatus is employed.
2. Locate the alarm button and emergency stop switch at 35", and floor and control buttons not more than 48" above the finished floor.
3. Provide raised markings in the panel to the left of the floor and control buttons. Letters and numbers shall be a minimum of 5/8" and raised .03" and shall be in contrasting color to the call buttons and cover plate.
4. The centerline of the hall pushbuttons shall be 42" above the finished floor.
5. The hall arrival lanterns or cab direction lantern provided shall sound once for the "up" direction and twice for the "down" direction. Design and locate fixtures(s) per Federal standards.
6. Replace any floor designation plates that are missing at each entrance and on both sides of jamb at a height of 60" above the floor. Designations shall be 2" high, raised .03" on a contrasting color background matching the existing.
  - a. Use cast metal plates and polished numbers secured with tamper-proof hardware if applicable. Replacements must match existing plates.
7. Provide an audible signal to tell passenger that the car is stopping or passing a floor served by the elevator.



8. Provide signal controls for passenger entry/exit transitions per Federal standards.
9. Ensure sill-to-sill running clearances do not exceed 1-1/4" at all landings served.
10. Provide visual call acknowledgment signal for cab emergency intercommunication device.

## 2.10 COMMUNICATIONS AND EMERGENCY SIGNALING DEVICES

### A. Harding Communication System:

1. Provide an automatic connection, hands-free two-way speaker in the new car station without a separate faceplate. All components shall be mounted to the back of the panel.
  - a. Provide Harding ICE-217-010 VoIP intercom station.
    - 1) The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.
2. The system shall be arranged to automatically communicate with the Capitol Police at the IMCS in the East Wing of the Capitol via the COWPA Network. Provide an automatic shut-off feature and a pushbutton to initiate a call.
3. The communication system shall be turned on by pressing the emergency alarm or designated pushbutton in the car panel. It shall automatically contact Capitol Police and alert them that there is a problem in the elevator.
4. Provide nicad battery backup to ensure operation under all conditions.
5. The Elevator Contractor shall install the instrument and all wiring, terminating it as an RJ-45 jack in the elevator machine room. The RJ-45 jack will provide connectivity to COWPA via the 5<sup>th</sup> floor IDF room.
6. All connections from the RJ-45 jack to the communication system shall be done by the Elevator Contractor. Provide dedicated CAT 6 and spare CAT 6 traveling cables as required for the Harding Communications System.
7. The entire system shall be designed and located in accordance with A.D.A. Standards to include visible call acknowledging, engraved advisories, etc.
8. The .4 Electrical Contractor shall provide the RJ-45 jack in the machine room and CAT 6 cable to the 5<sup>th</sup> floor IDF room.
9. The Client Agency shall arrange to have the Office of Administration IT provide a network address and connectivity to the IMCS.

### B. Emergency Alarm/Battery Back-up and Common Alarm Bell (New)

1. Provide a new car-mounted battery unit including solid-state charger and testing means enclosed in common metal container.
  - a. The battery shall be rechargeable nickel cadmium with a 10-year minimum life expectancy.
  - b. The alarm bell shall be mounted directly to the battery/charger unit and connected to sound when any alarm pushbutton or stop switch in the car enclosure is operated.
  - c. The bell shall be configured to operate from power supplied by the building emergency power generator.
2. Provide a new common alarm bell located in the elevator pit.

- a. The bell shall be configured to operate when the alarm or stop switch of any elevator is activated, during both normal and battery back-up power conditions.
- b. Existing common alarm bells may be rehabilitated and reused providing they meet the intent of this section and applicable codes.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT MANUFACTURERS

- A. The following manufacturers' equipment and materials, or equivalent as approved by the Professional, for use on this project. Other equipment not specifically mentioned shall be considered for approval on an individual basis by the Professional.
  - 1. Controller - Smartrise Engineering, GAL Galaxy, ESI Controls.
  - 2. Tracks, Hangers, Interlocks and Door Operators - G.A.L.
  - 3. Fixtures - G.A.L., EPCO, Monitor, C.E. Electronics, Innovation, PTL.
  - 4. Door Protective Device - Janus, G.A.L., T.L. Jones, Tri-Tronics.
  - 5. Entrances/Entrance Door Panels - EDI/ECI, EMCO, SmartTork.
  - 6. Machines - Torin Drive International, Hollister-Whitney
  - 7. Motors and Motor Generators - Torin, Imperial Electric, General Electric, Baldor, Reuland.
  - 8. VVVF Power Drives - Mitsubitsi, MagneTek, Yaskawa.
  - 9. Guide Rails - AFD Industries.
  - 10. Electrical Traveling Cables – Draka.
  - 11. Guide Shoes/Rollers – ELSCO.
  - 12. Wire Ropes - Paulsen, Bethlehem, Alps, Draka.

### 3.2 INSPECTION BY THE PROFESSIONAL

- A. Study the Contract Documents with regard to the work as specified and required so as to ensure its completeness.
- B. Examine surface and conditions to which this work is to be attached or applied and notify the Professional in writing, via an RFI in eBuilder, if conditions or surfaces are detrimental to the proper and expeditious installation of the work. Starting the work shall imply acceptance of the surfaces and conditions to perform the work as specified.
- C. Verify, by measurements at the job site, dimensions affecting the work. Bring field dimensions which are at variance with those on the accepted shop drawings to the attention of the Department and the Professional. Obtain the decision regarding corrective measures before the start of fabrication of items affected.
- D. Cooperate in the coordination and scheduling of the work of this section with the work of other sections so as not to delay job progress.

### 3.3 INSTALLATION

- A. Modernize the elevators, using skilled workmen in strict accordance with the final accepted shop drawings and other submittals.
- B. Comply with the code, manufacturer's instructions and recommendations.

- C. Coordinate work with the work of other building functions for proper time and sequence to avoid delays and to ensure right-of-way of system. Use lines and levels to ensure dimensional coordination of the work.
- D. Accurately and rigidly secure supporting elements within the shaftways to the encountered construction within the tolerance established.
- E. Provide and install motors, switches, controls, safety and maintenance and operating devices in strict accordance with the submitted wiring diagrams and applicable codes and regulations having jurisdiction.
- F. After installation, touch up in the field, surfaces of shop primed elements which have become scratched or damaged.
- G. Lubricate operating parts of system as recommended by the manufacturer.

### 3.4 PROTECTION AND CLEANING

- A. Adequately protect surfaces against accumulation of paint, mortar, mastic and discoloration or damage during shipment and installation.
- B. Upon completion, remove protection and thoroughly clean work and have it free from discoloration, scratches, dents and other surface defects.
- C. The finished installation shall be free of defects. Before final completion and acceptance of the building, repair and/or replace defective work, to the satisfaction of the Department and the Professional, at no additional cost.

### 3.5 BARRICADES AND HOISTWAY SCREENING

- A. The Contractor shall provide whatever barricades are necessary in order to maintain adequate protection of areas in which work specified by the Contract Documents is being performed, including open hoistway entrances. Fabrication and erection as all barricades shall be in compliance with applicable OSHA regulations.
- B. As required, the Contractor shall provide temporary wire mesh screening in the hoistway and of any elevator undergoing work specified in the Contract Documents. This screening shall be installed in such a manner as to completely segregate the hoistway from that of adjacent elevators. Screening shall be constructed from .041" diameter wire in a pattern that rejects passage of a 1" diameter ball.

### 3.6 PERFORMANCE AND OPERATING REQUIREMENTS

- A. Passenger elevators shall be adjusted to meet the following performance requirements:
  1. Speed: within 5% of rated speed under any loading condition.
  2. Leveling: within 1/4" under any loading condition.
  3. Typical Floor-to-Floor Time: Recorded from the doors start to close on one floor until they are 3/4 open at the next floor.  
Passenger Elevators: PE7 - 16.0 seconds.
  4. Door Operating Times for 42" center opening:
    - Opening - 1.6 seconds
    - Closing - 2.6 seconds

5. Door dwell time for hall calls: 4.0 seconds with Advance lantern signals.  
Door dwell time for hall calls: 5.0 seconds without Advance lantern signals.  
Door dwell time for car calls: 3.0 seconds.
6. Reduced non-interference door dwell time: 1.0 seconds.

B. Maintain the following ride quality requirements for the passenger elevators:

1. Noise levels inside the car shall not exceed the following:
  - a. Car at rest with doors closed and fan off - 40 dba.
  - b. Car at rest with doors closed, fan running - 55 dba.
  - c. Car running at high speed, fan off - 50 dba.
  - d. Door in operation - 60 dba.
2. Horizontal accelerations, peak to peak shall not exceed 18 milli g in the frequency range of 1 to 10 Hz.
3. Amplitude of acceleration and deceleration shall not exceed 4 feet per second, per second. A sustained jerk shall not be more than twice the acceleration. The rate of change in the acceleration/deceleration rate shall not be more than 8.0 ft/sec.<sup>3</sup>.

### 3.7 INSPECTIONS

- A. Upon completion of the work phase for the elevator modernization specified herein, the Contractor shall, at its own expense, arrange and assist with whatever inspections that are required by the L&I Elevator Division.

### 3.8 ACCEPTANCE TESTING

- A. The Contractor shall provide at least five (5) days prior written notice to the Department and the Professional regarding the exact date on which work specified in the Contract Documents will reach completion on any single unit of vertical transportation equipment. In addition to conducting whatever testing procedures may be required by local inspecting authorities in order to gain approval of the completed work, and before seeking approval of said work by the Department and the Contractor shall perform certain other tests in the presence of the Professional. To that end, the Contractor shall provide test instruments, test weights, and qualified field labor as required to safely operate the elevator under load conditions that vary from empty car to full rated load and, in so doing, to successfully demonstrate compliance with applicable performance standards set forth in the project specifications with regard to:

1. Sustained high-speed velocity of the elevator in either direction of travel;
2. Brake-to-brake running time between adjacent floors;
3. Floor leveling accuracy;
4. Ride quality inside the elevator car;
5. Load settings at which anti-nuisance, load dispatch, and load non-stop features are activated.

- B. Upon completion of work specified in the Contract Documents on the last car in any group of elevators, and in conjunction with the aforementioned testing procedures, the Contractor shall carry out additional testing of group dispatch/supervisory control features in the presence of the Professional. To that end, the Contractor shall provide test instruments and qualified field labor as required to successfully demonstrate:

1. The back-up operating mode for group dispatch failure;
2. Simulated and actual emergency power operation;

3. Restricted access security features;
4. Zoning operations and floor parking assignments;
5. Up/down peak operation;
6. Response to corridor calls that fall into the "long-wait" category;
7. Lobby dispatch operations.

### 3.9 SUBSTANTIAL COMPLETION

- A. The work shall be deemed "Substantially Complete" for an individual unit or group of units when, in the opinion of the Professional, the unit is complete, such that there are no material and substantial variations from the Contract Documents, and the unit is fit for its intended purpose.
  1. L&I Elevator Division testing shall be completed and approved in conjunction with inspection for operation of the unit; a certificate of operation or other required documentation issued; and remaining items mandated for final acceptance completion are limited to minor punch list work not incorporating any life safety deficiencies.
  2. The issuance of a substantial completion notification shall not relieve the Contractor from its obligations hereunder to complete the work.
  3. Final completion cannot be achieved until all deliverables, including but not limited to training, spare parts, manuals, and other documentation requirements, have been completed

END OF SECTION 142001

## SECTION 142003

### ELECTRIC TRACTION FREIGHT ELEVATOR MODERNIZATION

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes modernization of electric traction freight Elevator No. 8.
  - 1. Section 055000 "Metal Fabrications" for the following:
    - a. Pit ladders.
  - 2. Section 099600 "High Performance Coatings" for field painting of steel components.
  - 3. Section 283111 "Digital, Addressable Fire-Alarm System" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

##### 1.3 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

##### 1.4 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
  - 2. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.
- D. Qualification Data: For Installer.

- E. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.
- F. Sample Warranty: For special warranty.
- G. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified elsewhere for Operation and Maintenance Data, include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- H. Inspection and Acceptance Certificates and Operating Permits: As required by the Pennsylvania Department of Labor & Industry (L&I) Elevator Division unrestricted elevator use.
  - 1. Contractor shall prepare the L&I Elevator Division LIBI-26 Application for Construction and Alteration of a Lifting Device.
    - a. Coordinate seal and signature of the application with the Professional.
  - 2. Contractor shall provide a variance from the L&I Elevator Division for all existing non-complying conditions in the elevator machine room, such as the clearances beneath the transverse beams bisecting the machine room.

#### 1.5 QUALITY CONTROL

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

#### 1.6 CONTRACTOR SUPERINTENDENT

- A. The Contractor shall assign a competent project superintendent and Labor during the work progress and any necessary assistant, all satisfactory to the Department or the Professional. The superintendent shall represent the Contractor and all instructions given to him shall be as binding as if given to the Contractor.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

#### 1.8 COORDINATION

- A. Coordinate locations and dimensions of other work relating to electric traction freight elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

## 1.9 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
  2. Warranty Period: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL DESCRIPTION

- A. Elevators FRT8 A Total of one (1) Elevator:

1.	Quantity:	One (1) Freight Elevator
2.	Type:	Geared Overhead Traction
3.	Capacity (lbs.):	FRT 8 - 8000 / Retain Existing
4.	Speed (fpm):	FRT 8 – 150 F.P.M. / Retain Existing
5.	Travel in Feet:	Field Verify / Retain Existing
6.	Number of Landings:	FRT 8 – Six (6) @ G, 1, 2, 3, 4, 5
7.	Front:	FRT 8, – Six (6) @ G, 1, 2, 3, 4, 5 Retain Existing
8.	Rear:	None
9.	Operation:	FRT 8 – Simplex Operation (New)
10.	Control:	Microprocessor Control (New)
11.	Number of Pushbutton Risers	One riser (1) (New)
12.	Platform Size:	FRT 8 – 9'5" x 16'3" / Retain Existing
13.	Guide Rails:	Steel T's / Retain Existing
14.	Buffers:	Spring Buffers / Retain Existing
15.	Cab Enclosure:	No work performed to cab during the Modernization
16.	Car Door Size:	FRT 8 Front 10' Tall" x 16'3" / Rear 10'Tall x 12'7"
17.	Hoistway Door Size:	FRT 8 Front 10' Tall" x 16'3" / Rear 10' Tall x 12'7"
18.	Door Operation:	Peelle Door Operator, (New gate and door panels – New Door Operators)
19.	Fixture and Signals:	Standard Fixtures (New)
20.	Machine Type:	Geared Traction (New)
21.	Machine Location:	Overhead
22.	Power Supply:	480 VAC / 3 Phase / 60 HZ (Confirm and retain existing)



## 2.2 CONTROL FEATURES/FUNCTIONS

### A. Simplex Automatic Selective Collective Freight Operations (New)

1. The elevator shall automatically travel to landings for which a call demand exists. Stops in response to calls that are registered in either the car or corridor push-button stations shall occur in the natural order of progression in which the floors are encountered, depending on the direction of car travel, and irrespective of the order in which calls are registered. In responding to corridor calls, the elevator shall answer only those demands that correspond to the direction in which the car is traveling.
2. Call acknowledgment lights provided in both the car and corridor push-button fixtures shall be extinguished as the car begins its slowdown approach to the corresponding landing. Immediately after cancellation, a corridor call shall be inoperative until the elevator doors have completed their dwell time in the open position and commenced their closing cycle.

### B. Motion Control (New)

1. Smooth stepless acceleration and deceleration of the elevator car shall be provided in either direction of travel during both single and multiple floor runs. The amplitude of acceleration and deceleration shall not exceed 4.5 ft/sec<sup>2</sup>. The maximum velocity which the elevator achieves in either direction of travel while operating under load conditions that vary between empty car and full rated load shall be within  $\pm 2\%$  of the rated speed.
2. Floor leveling accuracy of  $\pm 1/4"$  as measured between the car entrance threshold and the landing sill on any given floor shall be provided. This accuracy standard shall be maintained under varying load conditions and without need for releveling corrections caused by overshooting or stopping short of the floor (spotting).
3. Brake-to-brake elapsed time during a typical elevator one floor run shall not exceed 5.5 seconds. Timing, as measured between initial brake lift and the moment the brake sets with the car position level at the next adjacent floor, shall remain consistent under varying load conditions in either direction of travel.
4. Elapsed flight time during a typical elevator one floor run shall not exceed 12.0 seconds. Timing, as measured between the moment door closing operations begin and when the doors are  $3/4"$  open at the next adjacent floor, shall remain consistent under varying load conditions in either direction of travel. Pre-opening operation shall be available should it be requested by ownership or their representative.

### C. Freight Elevator/Bi Parting Landing Door Operation (New)

1. Freight car and Bi Parting landing doors shall be arranged to operate in unison without excessive noise or slamming in either direction of travel. Door opening speeds shall be consistent in conjunction with closing speeds in accordance with governing code. Door operation shall be arranged to commence as the car enters its final leveling approach to a landing. In no case shall the door opening cycle conclude before the car comes to a complete stop at floor level.
2. Door open and door close elapsed time shall be measured between the moment car door operation in either direction begins and the instant at which that particular cycle is completed.
3. When responding to either a car or corridor call, the amount of time that the elevator doors remain stationary in the open position shall be adjustable anywhere up to sixty (60) seconds. Door open dwell time for corridor calls shall be separate of that for car calls, and in both cases, dwell time shall be canceled whenever the door close push button is depressed.

4. Where door protective devices are provided, the operation of the device by physical contact (mechanical safety-edge or sensor edge) or the interruption of one or more infrared light beams (dual or multi-beam non-contact) during the close cycle shall cause the immediate reversing of the doors to the full open position.
5. The door closing cycle shall be arranged so that, in the event the door protective devices become continually obstructed after the normal door open dwell time has expired, and following a time interval of approximately thirty (30) seconds (adjustable), a warning tone shall sound and the door closing cycle shall commence at reduced speed and torque per ASME A17.1 Code requirements if applicable.
6. Repeated attempts by the power door operator mechanisms to open or close the doors at any landing shall be monitored by the new microprocessor-control door system. In the event the doors should fail to cycle properly after a preset (adjustable) number of attempts, the door controller shall be capable of removing the door power system from operation.

D. Car Door Operation (New)

1. Car door shall be arranged to operate in unison with the corridor door safety interlock release mechanism. Door opening speeds shall be consistent in conjunction with closing speeds in accordance with governing code. Door operation shall be arranged to commence after the car enters its final leveling approach to a landing. In no case shall the door opening cycle conclude before the car comes to a complete stop at floor level with machine brake set.
2. When responding to either a car or corridor call, the amount of time that the elevator car door remains stationary in the open position shall be adjustable anywhere up to sixty (60) seconds.
3. Repeated attempts by the power car door operator mechanisms to open or close the car doors at any landing shall be monitored by the new microprocessor door control system. In the event the doors should fail to cycle properly after a preset (adjustable) number of attempts, the door controller shall be capable of removing the door power system from operation.

E. Hoistway Access Operation (New)

1. Provision shall be made to allow access to the hoistway through the use of hoistway access switches.
2. Operating the access switch shall permit the car to be moved at slow speed (inspection speed) with the doors open to allow authorized persons to obtain access to the top of the elevator car.
3. Access operation must be code compliant and conform to the current A17.1 Code for elevators and escalators.

F. Fire Emergency Operation (New)

1. Phase I - Emergency Recall Operation shall be provided for each car in accordance ASME/ANSI A17.1 code as modified under the applicable local or State law.
2. Each main car operating station shall be provided with an indicator light and warning buzzer, each of which shall become activated whenever Phase I Operation is engaged. The warning buzzer shall cease to function once the car has completed the recall sequence and is positioned at the designated recall landing. The indicator light shall remain illuminated as long as Phase I Operation is activated.
3. A three-position, key-operated switch shall be provided on the designated recall landing to manually activate Phase I Operation. When activated, Phase I Operation shall be arranged so that in order to reset normal service, all cars must first be returned to the designated recall landing, after which the Phase I key-switch must be turned to the "OFF" position.

4. Phase II - Emergency Recall In-Car Operation shall be provided for each car in accordance with ASME A17.1 code as modified under local or State law.
5. Each main car operating station shall be equipped with a three-position, key-operated switch to engage Phase II Operation on elevators which have completed the Phase I recall sequence, and which are parked at the designated recall landing or alternate floor landing. Subsequent to activating Phase II Operation on any elevator, that elevator must be returned to the designated recall landing in order to discontinue that service mode.
6. Each main car operating station shall be provided with a "CALL CANCEL" pushbutton that functions only under Phase II operating mode. When activated, pressing the "CALL CANCEL" button shall cause any previously registered car calls to cancel per ASME standards.
7. Each main car operating station shall incorporate the National Standard fire logo and/or operating instructions, engraved and red color filled, as required by the applicable local or State law requirements.

G. Smoke Detector System (New)

1. The elevator contractor shall coordinate with the .4 Electrical Contractor to provide a complete smoke detector system for elevator recall to comply with the governing authority's requirements and ASME A17.1 as approved or modified under local law. The new system shall be configured as follows:
  - a. Smoke detectors shall be installed in the elevator lobby at each floor, top of hoistway, in pit areas and associated elevator machine room in accordance with NFPA No. 72A through 72E, Automatic Fire Detectors, Chapter 4. The activation of a smoke detector in any elevator lobby or associated elevator machine room other than the designated level (first floor) shall cause all cars in all groups that serve that lobby to return non-stop to the designated level (ground floor). If the smoke detector at the designated level (ground floor) is activated, the cars shall return to an alternate level (first floor) unless the Phase 1 key-operated switch is in the "firemen service" position. Smoke detectors and/or smoke detector system shall not be self-resetting.
  - b. Elevator recall system shall incorporate a minimum number of zones as follows:
    - 1) Zone 1: Ground Floor.
    - 2) Zone 2: Alternate Floor (first floor).
    - 3) Zone 3: Machine Room.
    - 4) Zone 4: Top of shaft way.
    - 5) Zone 5: Pit.
    - 6) Zone 6: Fire hat.
    - 7) Zone 7: To all typical landings serviced.
  - c. The smoke detectors required for elevator recall shall be part of the building fire alarm system upgrade. All additional programming needed to allow the "tie in" to occur shall be at the expense of the elevator contractor.
  - d. Regarding Item c above, should any modifications to the existing fire alarm be required as part of the utilization of that system, the elevator contractor shall take full responsibility for its operation. Additionally, any cost associated with the above referenced work shall be included in the project pricing. No change orders shall be applicable under any circumstances.

#### H. Emergency Power Operation (New)

1. Provisions shall be included in all of the new elevator control systems whereby, immediately after transferring to the building emergency power system, all affected elevators shall automatically return to the main fire recall landing in progressive numerical sequence at normal operating speed. Car and corridor calls shall become inoperative, and all previously registered calls shall be canceled. As the car arrives at the designated landing, it shall park out of service with its door in the open position.
2. Upon completion of the recall process, one elevator shall respond as if it were in normal power mode (see Section 2.8 Fixtures for specific information regarding the panel). Upon power removal and normal power being restored to the building, a pre-initiation input to the elevator controller's computer shall cause the elevator to stop at the nearest available floor, if not already stopped, open its doors and wait for a power confirmation from a switch gear and the power with usable characteristics has been restored. The unit may then be allowed to go back into service.
3. An emergency power generator is present and in working order, including switch gear operation. The elevator contractor shall size, confirming all new loads to be acceptable for the new proposed elevator equipment, and provide all necessary connections and tie ins required to make the emergency generator functional and perform in a code compliant and acceptable manner.
4. The emergency power control panel shall have capacity to add two new 5,000 lb. MLR traction elevators to be added to the State Museum via future Phase 6.
5. Locate the emergency power control panel in Fire Command G-40A.

#### I. Independent Service Operation (New)

1. The car operating station shall be equipped with a key-operated switch labeled "IND SER". When placed in the "on" position, this switch shall cause the elevator to bypass all corridor calls and to travel directly to any floor chosen by registration of a car call. During Independent Service Operation, the elevator doors shall remain open at any landing until the door close or car call registration pushbutton, is pressed and maintained until the doors are fully closed.
2. In case an elevator is operating on the Independent Service mode and the Fire Emergency Recall system becomes activated, following a period of approximately forty-five (45) seconds, the elevator shall automatically override Independent Service Operation and engage Phase I - Fire Emergency Recall Operation.
3. If more than one (1) car call is registered, all registered car calls shall extinguish when the elevator stops in response to the first call.

#### J. Car Security Operating Controls (New)

1. Provide necessary software/hardware to operate security feature for all car calls and each floor push button for all landings served.
2. Arrange special key operated switch located in the COP (behind locked door) to override the security system functions.
3. Override security controls with fire emergency controls in accordance with code and local laws.
4. Provide all Security System Interface and Camera Control Wiring as necessary including "wire and terminations" to operate the above referenced control systems. Mounting the card readers and security cameras shall be the responsibility of the Security Contractor, however the elevator contractor shall allow access and supply assistance on an as needed basis free of additional charge should access be requested.
  - a. Provide necessary provisions (including software) for security service for each elevator and its associated interface between outside vendor (Security Company) and elevator system.

- b. Provide and identify a manual override toggle switch on the exterior of the group or master controller that will remove all of the units from security mode. The switch must be identified by a permanent label with lettering at least three (3) inches tall and shall be accessible by building personal.
- c. Power Supplies and incidentals required for the card readers and or security cameras shall be supplied by the security contractor. The elevator contractor shall supply the appropriate power source (120 VAC) to the vicinity in which the power source is required to operate the security contractor's equipment in an efficient and acceptable manner.
- d. Should an interface box need to be utilized between the security contractor and elevator equipment the security company shall supply and mount the box in an acceptable location. The elevator contractor shall provide the appropriate pipe and wire to accomplish the required tasks and shall work together with the security contractor to terminate and make the appropriate connections as required in both the elevator controller and interface box.
- e. Provide the required wiring for card reader access and camera controls to be included in the traveling cables. Before ordering the wire the elevator contractor shall confirm the type of wire required with the security company. Splicing of wire or wires will not be accepted.

K. Provide Fire Service interface provisions (New)

- 1. Provide to tie in and make operational fire emergency control interface provisions consisting of primary, alternate and flashing hat subject to activation by fire sensing devices (ref. NFPA 72E, Chapter 4) located in the elevator machine rooms, the hoistways, or in the elevator lobby on any landing other than the designated fire recall landing (Main Floor). The contacts shall be wired to an electrical junction box located inside each elevator machine room for connection to the elevator control systems by the Contractor. Each wire shall be clearly labeled with its control function.

## 2.3 MACHINE ROOM EQUIPMENT

A. Control Equipment (New)

- 1. A new microprocessor-based elevator control system shall be provided. This equipment shall utilize digital logic to calculate optimum acceleration and deceleration patterns for the car to follow during each run. Closed-loop distance and velocity feedback shall be provided to monitor the degree to which actual performance of the elevator car conforms to the desired speed profile. Basic systems operating software shall be stored in non-volatile, electrically programmable read only memory (EPROM), whereas field adjustable parameters shall be stored in an electrically erasable programmable read only memory (EEPROM).
- 2. Elevator control relays, contactors, switches, capacitors, resistors, fuses, circuit breakers, overload relays, power supplies, circuit boards, static motor drive units, wiring terminal blocks and related components shall be totally enclosed inside a free-standing metal cabinet with hinged access doors. Control equipment cabinets shall be provided with forced air ventilation to prevent overheating of the electrical components housed therein.
- 3. All electrical wiring inside the control equipment cabinet, whether done in the factory or at the job site, shall be performed in a neat, workmanlike manner. All field wiring shall terminate at stud blocks provided inside the control equipment cabinet for that purpose. Each wiring terminal shall be clearly identified according to the nomenclature used on the "as built" wiring diagrams. No more than two (2) field wires may be connected to any single terminal stud. Spare wires shall be tagged according to their point of termination, bundled, and neatly placed at the bottom of the control equipment cabinet.

4. Alphanumeric identification symbols shall be permanently affixed to each electrical component housed within the control equipment cabinet. These identification symbols shall be identical to those depicted on the "as built" wiring diagrams.
  5. A 14" or larger CRT display monitor shall be provided inside the elevator machine room for diagnostic purposes. By means of graphic depiction, information available on the screen shall include:
    - a. An overview of car and corridor calls currently existing within the system.
    - b. Elevator operating status.
    - c. Elevator position, direction of travel and velocity.
    - d. The open/close status of elevator doors.
    - e. The current operational status of each CPU input and output.
    - f. A sequential history of faults detected within the control system over the previous thirty (30) days.
  6. In case placement of new elevator control equipment cabinets inside the machine rooms should interfere with direct sight lines between the main line disconnect switch and rotating equipment belonging to the affected elevator, an auxiliary locking disconnect switch shall be provided. The mounting location of this auxiliary disconnect switch shall be chosen so as to provide clear sight of the associated rotating equipment.
- B. Worm Geared Traction Machines (New – with New AC Motor)
1. Machine Beams (Existing)
    - a. Provide additional support beams, angles, plates, bearing plates, blocking steel members, etc., to support new machine, governors, dead end hitches, deflector and overhead sheaves from existing machine beams if applicable. Contractor is required to verify adequacy of existing machine support and report any inadequacies via an RFI in eBuilder.
  2. Geared Traction Machine and Deflector Sheaves (New)
    - a. Provide a new worm-gearred traction machine with motor, DC brake and demountable drive sheave, mounted in proper alignment on a common bedplate. The worm shall be accurately machined from steel and provided with a single end, double race ball bearing thrust. The worm gear shall be made from a phosphor bronze rim, accurately cut, fitted and bolted to a cast iron spider. The drive sheave shall be a demountable casting from the best grade of metal with a Brinell hardness of 215 to 230, and shall be machined with grooves, providing maximum traction with a minimum of cable and sheave wear. Provide means for lubricating the machine. The gear housing shall have a gasketed hole to inspect the gear.
    - b. Provide machine with an electro-mechanical brake. The brake shall be spring applied and electrically released. Swivel type brake shoes shall be applied to the braking surface simultaneously and with equal pressure by means of helical compression springs. Design the brake electro-magnet for quick release to provide smooth and gradual application of brake shoes.
    - c. Span the distance between the car and counterweight with an accurately grooved new deflector sheave. Mount the new deflector sheave to the bedplate in the machine room. Provide sheave guards to prevent ropes from jumping off grooves and to prevent possible entrapment on both sides of the floor penetrations.
    - d. Provide sound reducing vibration isolation elements at all support points of the elevator hoisting motors and machines. Elements between the hoisting machine (unitized base) and machine support beams shall be similar to triple (3) layer ribbed neoprene pads, separated by appropriate steel shims as manufactured by Mason Industries, Type W pads, at 50 durometers, loaded for 40 psi. All bolts through isolation elements, where necessary, are to incorporate resilient washers and bushings.

- e. Provide hoist cable guards at the car and counterweight drop side of the hoisting machine sheave to prevent accidental contact with the hoisting cables. The guard shall extend from the point where the hoisting cables penetrate the machine room floor slab to a point beyond where the cables contact the traction and new deflector sheaves. The guards shall also be constructed so as to conceal pinch-points between cables and sheave grooves.

### 3. Machine Brake (New)

- a. Provide the hoisting machine with a spring applied and electrically released electromechanical brake. Swivel type brake shoes shall be applied to the braking surface simultaneously and with equal pressure by means of helical compression springs. Design brake electromagnet for quick release to provide smooth and gradual application of the brake shoes.
- b. Brakes shall be designed and adjusted to safely hold 125% of rated full load capacity in accordance with applicable code.

### 4. AC Drive Motor (New)

- a. Provide a new variable speed, reversible alternating current induction motor with high starting torque and low starting current, rated for 50° C (122° F) during continuous operation, designed for this particular elevator application.
  - 1) Ensure that adequate ventilation of internal stator windings and rotating element is provided to prevent overheating with thermal overload protection.
- b. The new hoist motor housing shall have a rigid cast iron stator frame for maximum strength and rigidity. Core Plate stator laminations shall be press fit into frame and properly secured. Stator windings shall be insulated with Mylar Paper laminate, formed and fit to core.
- c. New rotating element shall be fabricated from drawn bars machined and fitted in slots with end rings brazed together. Complete rotating element shall be dynamically balanced for vibration-free operation.
- d. Motor shaft shall be manufactured from carbon hot rolled steel for maximum strength.
- e. Properly align new hoisting motor and make all necessary electrical connections to the control circuitry.

### C. VVVF AC Drive (New)

- 1. A solid-state, variable voltage, variable frequency (VVVF), 3-phase AC hoist motor drive system shall be provided as an integral part of the new microprocessor-based equipment. The primary component of this VVVF drive system shall be a low-noise, flux-vector inverter device, featuring a digital LED readout and touch-key pad, designed to facilitate software parameter adjustments, monitor systems' operation and display fault codes.
- 2. In addition to an inverter, the VVVF drive unit shall consist of a separate dynamic braking module to reduce hoist motor deceleration time, a resistor bank to absorb power regenerated by the hoist motor, and a HP rated 3-phase AC contactor with overload protection to disconnect the inverter from the hoist motor whenever the elevator is stopped.
- 3. The system shall be designed and configured with countermeasures for noise generated by the pulse-width modulated (PWM) inverters. Countermeasures shall include; but are not limited to, control of radiated noise via inverter and/or motor cables, conducted noise through power lines, induction noise and ground noise.

- a. Inverter device shall be encased in metal and properly grounded independently.
- b. A noise filter for the input power line shall be provided to prevent penetration into radios, wireless equipment and detectors.
- c. Provide interconnection wiring and ground cables in accordance with the manufacturer's design requirements.

D. Governor (New)

- 1. Provide a speed governor, located overhead, to operate the car safety.
  - a. Maintain the proper tension in the governor rope with a weighted tension sheave located in the pit. Springs used to develop the tension are not acceptable.
  - b. Provide rope grip jaws, designed to clamp the governor rope to actuate the car safety upon a predetermined overspeed downward. Rope grip jaws directly coupled to the governor mechanism so as to float with governor movement shall not be permitted.
  - c. Centrifugal type governors shall trip and set rope jaws within 60 degrees of governor sheave rotation after reaching rated tripping speed.
  - d. Design the governor rope-tripping device so that no appreciable damage to or deformation of the governor rope shall result from the stopping action of the device in operating the car safety.
  - e. Provide an electrical governor overspeed protective device which, when operated, shall remove power from the driving machine motor and brake before or at the application of the safety. The setting for the overspeed switches shall be as prescribed in the ASME A17.1 Code.
    - 1) Locate and enclose the switch to insure that excess lubrication will not enter the switch enclosure.
    - 2) Overspeed switches shall operate in both direction of travel on systems employing static power drive units.
  - f. Seal and tag the governor with the running speed, tripping speed and date last tested.

E. Equipment Isolation (New)

- 1. Provide sound reducing vibration isolation elements at all support points of elevator controller, solid-state motor drives, isolation transformers, hoisting motors and machines. The elements for controllers, solid-state motor drives and isolation transformers shall be similar to double deflection neoprene-in-shear mounts, as manufactured by Mason Industries, Type ND, with 0.35" static deflection under design load ratings. Elements between the hoisting machine (unitized base) and machine support beams shall be similar to triple (3) layer ribbed neoprene pads, separated by appropriate steel shims as manufactured by Mason Industries, Type W pads, at 50 durometers, loaded for 40 psi. All bolts through isolation elements, where necessary, are to incorporate resilient washers and bushings.

F. Deflectors and Idler Sheaves (New)

- 1. Provide new overhead and/or machine room wire rope cable deflector sheaves with related apparatus and structural mounting supports.
- 2. Locate and size new sheaves to maximize use of available clearances maintaining the present car and counterweight hitch drops.
- 3. New support bearings shall be of a roller type designed for a minimum of twice the total load calculation equipped with pressure activated or other suitable lubrication devices.



4. Required mounting beams and structural supports shall be interfaced with existing building structures modified under the terms of this contract for the new design rated and located loading.
5. Provide sheave guards for all apparatus and secure same to supporting building elements.

G. Ascending Car Overspeed Protection Device (New)

1. Provide a device designed to prevent an ascending elevator from striking the hoistway overhead structure.
2. The device shall decelerate the car with any load up to the rated capacity by applying an emergency brake.
  - a. The device shall detect an ascending car overspeed condition of not greater than 10% higher than the speed that the car governor is set to trip.
  - b. The device, when activated, shall prevent operation of the car until the device is manually reset.
  - c. The device shall meet the requirements of the ASME A17.1 Safety Code as may be modified by the Authority Having Jurisdiction.

H. Unintended Car Movement Protection Device (New)

1. Provide a device to prevent unintended car movement away from the landing when the car and hoistway doors are not in the closed and locked.
  - a. The device shall prevent such movement in the event of failure of:
    - 1) The electric driving machine motor
    - 2) The brake
    - 3) The machine shaft or shaft coupling
    - 4) Gearing
    - 5) Control system
    - 6) Any component upon which the speed of the car depends
    - 7) Suspension ropes and the drive sheave of the traction machine are excluded.
  - b. The device shall prevent operation of the car until the device is manually reset.
  - c. The device shall meet the requirements of the ASME A17.1 Safety Code as may be modified by the Authority Having Jurisdiction.

I. Freight Door Control Equipment (New)

1. A new microprocessor-based Freight door control system shall be provided. Closed-loop distance and velocity feedback shall be provided to monitor the degree to which actual performance of the elevator car conforms to the desired speed profile. Basic systems operating software shall be stored in non-volatile, electrically programmable read only memory (EPROM), whereas, field adjustable parameters shall be stored in an electrically erasable programmable read only memory (EEPROM).

## 2.4 HOISTWAY APPARATUS

A. Car and Counterweight Guide Rail Systems (Reuse)

1. Car and counterweight guide rails, fish plates, rail brackets, backing support and related attachments shall be inspected to determine if unfavorable conditions exist that diminish the structural integrity of any component. In the event substandard conditions are disclosed by means of this inspection, the Contractor shall immediately inform the Department and the Professional as to the exact nature of said problems and then undertake whatever repairs and/or replacements the Professional may deem appropriate to remedy the situation.
2. Each stack of car and counterweight guide rails shall be individually examined to determine if excessive compression has occurred from building settlement. In the event such conditions are found to exist, each affected stack shall be cut off enough to relieve pressure. Jacking bolts shall be provided underneath each stack of both car and counterweight guide rails.
3. Each stack of car and counterweight guide rails shall be realigned so that total deviation from plumb in any direction does not exceed 1/8" over the entire length of the hoistway and that DBG measurements never vary more than .030".
4. As required, car guide rails joints shall be individually filled, filed and sanded in order to eliminate minor variations in adjoining machined surfaces.
5. Apart from the guide rail systems' reconditioning work specified herein, the Contractor shall perform whatever additional work may be required so that side-to-side and front-to-back acceleration of the elevator car traveling at full rated speed in either direction over the entire length of the hoistway with loads varying from empty car to full rated load never exceeds 18 milli-g peak to peak.

B. Counterweight Assembly (Reuse)

1. The existing counterweight assembly shall be refurbished to as new condition and reused. Individual counterweight frame members shall be inspected for any indication of damage and to determine if the overall assembly is twisted, racked, or otherwise distorted. In case any of these conditions are found to exist, the Contractor shall immediately inform the Department and the Professional about the exact nature of the problem and undertake whatever corrective action the Professional may deem appropriate to remedy the situation. All fastenings between counterweight frame members shall be individually examined, tightened and if necessary renewed.
2. The amount of filler weight placed within the counterweight frame shall be adjusted so the weight of the entire counterweight assembly is equal to that of the renovated elevator car, plus 40-50% of its rated loading capacity. Filler weights shall be held securely in place at all times with tie rods passing through holes in both the weights and the counterweight frame. Tie rods shall be secured on each end with double lock nut and a cotter pin arrangement.

C. Slide Guides (New) (Car & Counterweight)

1. Provide new sliding-type guide shoes and securely bolt them to the car frame at top and bottom.

D. Hoist Cables and Governor Cables (New)

1. Existing wire rope hoisting, and governor cables shall be removed and replaced with new.
  - a. Hoisting Cables - New pre-formed traction steel wire ropes, specifically constructed for elevator applications, shall be provided for suspension of the elevator car and counterweight assembly. New hoist cables shall be identical in number and construction to those which are currently in use.



- a. Traveling cables exceeding 100' in length shall be provided with a steel wire rope support strand from which the cable shall be suspended.
- b. Traveling cables must be contained within an approved electrical conduit to within 6' of the final suspension point in the hoistway.
- c. Each new traveling cable shall be arranged to provide no fewer than six (6) individually shielded pairs of 22-gauge wire and arranged to contain no less than one (1) coaxial cable for CCTV remote monitoring and required quantity of CAT 6 cables for the communications system.
- d. Traveling cable conductors that terminate at a hoistway center box shall be connected to stud block provided for that purpose. Each wiring terminal shall be clearly identified by its nomenclature as shown on the "as built" wiring diagrams and solderless, crimp-on type wire terminals shall be used where possible.
- e. The attachment of a traveling cable to the underside of the elevator car shall be performed so that a minimum loop diameter of 30x the cable diameter is provided.

G. Hoistway Projections and Setbacks

- 1. The top surface of any setback or projection in the hoistway that measures 2" or more in width shall be beveled at an angle of not less than 75 degrees from horizontal. Each bevel plate shall be constructed from prime painted 14 gauge cold-rolled steel and installed so as to conform to Rule 100.6 of ASME A17.1 elevator safety code.

2.5 PIT APPARATUS

A. Existing Car and Counterweight Buffers (Reuse)

- 1. The present spring buffers shall be reused in place. All springs, supports and related equipment shall be checked to assure it conforms to governing Codes. If repair or replacement of components is required, they shall be included under this specification. In case problems are found to exist, the Contractor shall immediately inform the Department and the Professional and then undertake whatever repairs and/or replacements the Professional may deem appropriate to remedy the situation. Surface rust shall be removed from all reused components.
- 2. Upon substantial completion of all work described in the project specifications, buffers shall undergo testing in accordance with ASME A17.1 Code.

B. Governor Cable Tension Assembly (New)

- 1. Provide a new governor cable tension assembly.
  - a. Maintain the proper tension in the governor rope with a weighted tension sheave located in the pit. Springs used to develop the tension are not acceptable.
  - b. The sheave shall be of proper diameter and set directly plumb with the governor cable drop to prevent the cable from pulling off of the sheave at an angle.
  - c. Lubrication fittings shall be provided on the assembly.
  - d. The assembly shall have necessary cable guards to prevent accidental contact of the cable/sheave by service personnel. Guards shall also be provided to prevent the governor cable from jumping off of the sheave.

C. Pit Stop Switch (New)

1. As pit depth exceeds 66", each elevator pit shall be provided with two (2) push/pull or toggle switches that are conspicuously designated "EMERGENCY STOP". Both of these stop switches, shall be located immediately adjacent to the pit access ladder. One of the stop switches shall be placed approximately 48" above the pit floor while the other stop switch shall be positioned approximately 18" above the hoistway entrance sill on the lowest landing served. These switches shall be arranged so as to prevent the application of power to the hoist motor or machine brake when either one is placed in the "off" position.

2.6 HOISTWAY ENTRANCES

A. Landing Door Tracks, Hangers, Hoistway Doors and Gates, Gibs, Relating Chains, Interlocks and Related Appurtenances (New)

1. Formed or extruded steel landing door hanger tracks as manufactured by Peelle Corporation or an approved equal shall be provided.
2. Each bi parting landing door panel shall be suspended from a pair of new door relating chain hanger assemblies that are compatible with the new assemblies. Guide assemblies shall be directly mounted to the door panel using the appropriate hardware. Guide assemblies shall be adjusted or shimmed so that door panels are suspended in a plumb manner with no more than the code mandated vertical clearance to the cab entrance threshold. The doors shall be adjusted for minimal operating clearance against the bottom edge of the hanger track.
3. Non-typical mounting arrangements for interlocks and/or related mechanisms must receive prior approval from the Professional.
4. Each hoistway door interlock assembly shall be provided with an emergency release mechanism utilizing the appropriate type access key at all landings served.

B. Retiring Cams (New)

1. Remove the existing retiring cam and provide a new assembly capable of operating in the same fashion as the original assembly.
2. Adjust for proper operation in accordance with current ASME A17.1 design standards.
3. Check the engagement and operability of the new retiring cam to confirm that it will operate with reliability and longevity as designed by the manufacture.

C. Master Freight Door Operating System (New to be interfaced with the new Controls)

1. Furnish and install a new heavy-duty Freight door master electric power door operator on the elevator car top. Design this operator to operate the Freight car and hoistway door simultaneously.
  - a. Designate this type of operator as a heavy duty operator. Design the door panels to operate at an average opening speed. Automatic closing of the car and hoistway doors shall be required and the closing speed shall be code complaint. Reduce this closing speed as required to limit the kinetic energy of the closing doors to the values permitted by the ASME Code.
  - b. The doors shall operate smoothly without a slam in both the opening and closing directions. Cushion the doors in their final movement in both directions of travel by electrical means (dynamic braking) only. Air dashpots or hydraulic dampening will not be accepted. Use electrical power to open and close the doors.

- c. In case of interruption or failure of electric power from any cause, the door operating mechanism shall be so designed that it shall instantly permit emergency manual operation of both the car door and the hoistway door, and the hoistway door shall continue during emergency operation to be self-locking, and self-closing. The door operator shall operate in conjunction with or be equipped with all interlocks and safety contacts specified.
- d. Construct all door operating levers of heavy steel members. All pivot points shall have either ball or roller bearings, or bronze bushings, of ample size. All brackets and other supports required to support door-operating mechanism shall be furnished and installed.

D. Car Door Hangers, Sheaves, Tracks and Gate Switch (New)

- 1. Provide a heavy duty type suspension hangers and tracks for each car door. Sheaves shall be hardened steel with sealed grease packed precision ball bearing.
- 2. The sliding door gibs/retainers shall be door mounted on the door assembly and arranged to ride on the side of the track.
- 3. The track shall be of formed cold rolled steel or cold drawn steel and shall be rounded on the track surface to receive the hanger sheaves. The track shall be removable.
- 4. Provide a new gate switch that connects directly to the car door track. The gate switch shall prevent movement of the elevator until such time as it signals the control equipment that the car door has physically closed.

E. Door Reopening Device (New)

- 1. Provide a code compliant gate door protection system.
- 2. The doors shall be prevented from closing from an open position if a person interrupts its direction of travel. When the doors are closing, any interruption of the protective shield shall cause both the car and corridor doors to reverse. The doors shall start to close when the protection system is free of any obstruction.

F. Refer to Specification Section 099600 "High Performance Coatings."

2.7 CAR APPARATUS/FRAME

A. Car Frame (Reuse)

- 1. The existing car frame assembly shall be refurbished to as-new condition and reused. Individual car frame members, platform isolation framework, door operator support structure, related bracing and appurtenances shall be inspected for any indication of damage and to determine if the overall assembly is twisted, racked or otherwise distorted. In case any of these conditions are found to exist, the Contractor shall immediately inform the Professional and then undertake whatever corrective action the Professional may deem appropriate to remedy the situation. All fastening between the aforementioned components shall be individually examined, tightened and if necessary renewed.
  - a. Provide new elastomer isolation pads for all existing platforms.
- 2. The existing car frame, door operator support structure and related bracing shall be modified or reconfigured as necessary in order to accommodate the new cab enclosure and/or related master door operating equipment specified herein.
- 3. The elevator car shall undergo static balancing upon substantial completion of all work described in the project specifications and subsequent to any car interior refinishing or cab replacement work performed in conjunction with the project.

B. Platform (Reuse)

1. Existing platform shall be modified to accommodate the new apparatus specified herein.
  - a. Underside of platform shall be refurbished and treated with fire-rated material.
  - b. Top of platform shall be refurbished with marine grade plywood set to receive new 12-gauge diamond plate floor.
  - c. Provide a new safety access "hole ring and cover assembly" to match selected cab finishes.

C. Safety (Reuse)

1. The existing governor actuated car safety device shall be retained, overhauled and upgraded for current code compliance.
2. Readjust safety for proper operation in accordance with current ASME A17. design standards.
3. Check the existing safety-operated switch (plank-switch) for proper adjustment and operation. Provide a new plank-switch where none currently exists.
4. Provide and check the existing safety release tool for proper adjustment and operation. Mount the releasing tool in the machine room in plain sight on the machine room wall. Provide a label above the tool stating that it shall not be removed from the machine room.

D. Automatic Leveling/Releveling Device (New)

1. Equip the elevator with a floor-leveling device which shall automatically bring the car to a stop within 1/4" of floor with any floor for which a stop has been initiated regardless of load or direction of travel. This device shall also provide for releveling which shall be arranged to automatically return the elevator to the floor in the event the elevator should move below or above floor level in excess of 1/4".
2. The leveling device may be separate from, or an integral part of the hoistway encoding and positioning system.

E. Top-of-Car Operating Station (New)

1. A new operating station shall be provided on top of the elevator car. This station shall be installed so that the controls are plainly visible and readily accessible from the hoistway entrance without stepping on the car.
2. The new top-of-car operating station shall be provided with the following control devices and appurtenances:
  - a. A push/pull or toggle switch designated "EMERGENCY STOP" shall be arranged so as to prevent the application of power to the hoist motor or machine brake when in the "off" position.
  - b. A toggle switch designated "INSPECTION" to activate the top of car Inspection Service Operation.
  - c. Pushbutton designated "Up", "Down" and "Safe" to operate the elevator on Inspection Service (the "Safe" button shall be arranged to operate in conjunction with either the "Up" or "Down" button).
  - d. An indicator light and warning buzzer that are subject to activation under Phase I - Fire Emergency Recall Operation.

F. Car Enclosure Work Lights and Receptacles (New)

1. The top and bottom of each car shall be provided with a permanent lighting fixture and 110-volt receptacle. Light control switches shall be located for easy accessibility from the hoistway entrance. Where sufficient overhead clearance exists, the car top lighting fixture shall be extended no less than 24" above the crosshead member of the car frame. Light bulbs shall be guarded so as to prevent breakage or accidental contact.

G. Emergency / Access Top Door (Top)

1. Ensure they operate as per code and provide or have proper electrical contacts and mechanical locks on the exterior of the cab enclosure.
2. Should side exits exist they shall be securely bolted shut so that they cannot be used in accordance with applicable code.
3. Provide additional support to the emergency exit hatch that will prevent it from giving way and falling into the elevator cab.

H. Finishes: Refer to Specification Section 099600 "High Performance Coatings."

2.8 FIXTURES (NEW)

A. Main Car Operating Panels (New)

1. Provide main and auxiliary car operating pushbutton panels on the inside front return panel of the car. The main panel shall be mounted on the right side while standing inside the cab looking into the hallway.
2. The pushbuttons provided for each floor served shall cause the car to travel to the floor on momentary pressure of the button.
3. The pushbuttons shall become individually illuminated as they are pressed. The button lights shall be extinguished as the calls are answered. LED-type bulbs are required to be utilized on all fixtures.
4. The operating panel shall include:
  - a. A call button for each floor served.
  - b. "Door open" / "Door close" buttons.
  - c. "Alarm" button (Interfaced with emergency alarm).
  - d. "Emergency Stop" switch per local law.
  - e. Door open hold push button / Parameter adjustable
  - f. Harding hands-free communication system with call acknowledging feature and A.D.A. design provisions for direct communication to the Capitol Police Command Center (IMCS) in the East Wing of the Capitol.
  - g. Three (3) position firefighter key operated switch, call cancel button and illuminated visual/audible signal system with mandated signage engraved per ASME Standards and/or local law requirements.
  - h. Provide a locked service cabinet flush mounted and containing the key switches required to operate and maintain the elevator, including, but not limited to:
    - 1) Independent service switch
    - 2) Light switch.
    - 3) Multiple speed fan switch.
    - 4) G. F. I. duplex receptacle.
    - 5) Emergency light test button and indicator.
    - 6) Inspection Service Operation key switch.



- 7) Security override Operation keyed switch. (The keyed switch shall be cut differently than all other switches and provide the standard on/off type function)
  - i. Car operating panel shall be flush mounted with swing type, one-piece faceplate with heavy-duty concealed hinges.
  - j. The auxiliary operating panel shall provide space for a card reader unit to be mounted behind a plexiglass panel centrally located within easy access for ADA accessibility the riding public.
  - k. Car operating panel shall incorporate a red digital LED floor position indicator, emergency light lens unit and black-filled engraved unit I.D. number or other nomenclature, as approved by Professional, with a "No Smoking" advisory and the rated passenger load capacity.
  - l. Provide the Car operating panel "full length design" as to cover all pre-existing cutouts or blemishes.
  - m. The certificate frame shall be incorporated into and made part of the fixture.
  
- B. Car Position Indicator (New) (Incorporate into Car operating panels)
  - 1. The position of the car in the hoistway shall be indicated by the illumination of the position indicator numeral corresponding to the floor at which the car has stopped or is passing.
  - 2. Provide 2" high, 10-segment red LED type position indicator with direction arrows, integral with the car operating panel.
    - a. Provide Lexan cover lens with hidden support frame behind fixture plate to protect the indicator readout,
    - b. Provide audible floor passing signal per ADA standards.
  
- C. Voice Annunciator (New)
  - 1. Provide a voice annunciator in each elevator. Coordinate size, shape and design with Designer and other trades. The system shall include, but not limited to:
    - a. Solid state digital speech annunciator.
    - b. A recording feature for customized messages.
    - c. Playback option.
    - d. Built-in voice amplifier.
    - e. Master volume control located and identified for easy access.
    - f. Audible indication for selected floor, floor status or position, direction of travel and nudging.
  - 2. Locate all associated equipment in a single, clearly labeled enclosure located either in the machine room and/or on car top or COB station.
  
- D. Car Direction Lantern (New)
  - 1. Provide a traveling lantern with visual and audible signal in the edge of the return post. The lens shall project a minimum of 1/4" and shall be of solid plexiglass. Use tamperproof screws and mount stainless steel faceplate flush with hairline joint.
  - 2. Car lantern shall indicate the direction of travel when doors are 3/4 open.
  - 3. The unit shall sound once for the "up" direction and twice for the "down" direction.
  
- E. Surface-Mounted Corridor Push Button Stations (New)
  - 1. Provide new corridor push buttons as further described:

- a. Provide two risers of new surface-mounted push button signal fixtures with elongated faceplates shall be provided on each landing. Each new signal fixture shall consist of a illuminating push buttons measuring 3/4" at their smallest dimension as selected by the Professional. New signal fixtures shall be installed directly over top of recessed mounting utilized by the existing corridor fixtures and shall be positioned so as to achieve a centerline button height of 42" above the floor. New signal fixture faceplates shall be installed both plumb and flush to the finished wall.
- b. Each intermediate landing shall be provided with signal fixtures containing two (2) push buttons while terminal landings shall be provided with fixtures containing a single push button. These buttons shall be arranged to become illuminated on an individual basis as "up" or "down" calls are registered and shall remain so until canceled.
- c. Provide engraving of each cover plate with fire logo, no smoking or other advisory, in compliance with code and as selected by Professional, to help fill the extension face cover void.

F. Cab Emergency Lighting (New) (Incorporate into each Car operating panel)

- 1. Provide an emergency lighting system to power an emergency lighting fixture and associated components incorporated in the car for at least four (4) hours in accordance with ANSI A17.1 code requirement.
- 2. Provide nickel cadmium batteries and a charger and mount the power pack on top of car.
- 3. Arrange for completely automatic operation when normal power is interrupted.
- 4. Provide a test button and indicator light in the car station.
- 5. Incorporate lighting lens unit within car operating panel (flush mounted).

G. Fixture Attachment, Finish and Design

- 1. Graphics shall be selected by the Professional.
- 2. The faceplates shall be stainless steel, 1/8" thick minimum.
  - a. No. 4 directional finish.
- 3. Mount fixtures with tamperproof screws. The screw and keyswitch cylinder finishes shall match faceplate finish.
- 4. Where key-operated switches and/or key-operated cylinder locks are furnished in conjunction with any component of the installation, keys for each individual switch or lock shall be furnished, stamped or permanently tagged to indicate function.

## 2.9 COMMUNICATIONS AND EMERGENCY SIGNALING DEVICES

A. Harding Communication System:

- 1. Provide an automatic connection, hands-free two-way speaker in the new car station without a separate faceplate. All components shall be mounted to the back of the panel.
  - a. Provide Harding ICE-217-010 VoIP intercom station.
    - 1) The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.

2. The system shall be arranged to automatically communicate with the Capitol Police at the IMCS in the East Wing of the Capitol via the COWPA Network. Provide an automatic shut-off feature and a pushbutton to initiate a call.
3. The communication system shall be turned on by pressing the emergency alarm or designated pushbutton in the car panel. It shall automatically contact Capitol Police and alert them that there is a problem in the elevator.
4. Provide nicad battery backup to ensure operation under all conditions.
5. The Elevator Contractor shall install the instrument and all wiring, terminating it as an RJ-45 jack in the elevator machine room. The RJ-45 jack will provide connectivity to COWPA via the 5<sup>th</sup> floor IDF room.
6. All connections from the RJ-45 jack to the communication system shall be done by the Elevator Contractor. Provide dedicated CAT 6 and spare CAT 6 traveling cables as required for the Harding Communications System.
7. The entire system shall be designed and located in accordance with A.D.A. Standards to include visible call acknowledging, engraved advisories, etc.
8. The .4 Electrical Contractor shall provide the RJ-45 jack in the machine room at CAT 6 cable to the 5<sup>th</sup> floor IDF room.
9. The Client Agency shall arrange to have the Office of Administration IT provide a network address and connectivity to the IMCS.

**B. Emergency Alarm/Battery Back-up and Common Alarm Bell (New)**

1. Provide a new car-mounted battery unit including solid-state charger and testing means enclosed in common metal container.
  - a. The battery shall be rechargeable nickel cadmium with a 10-year minimum life expectancy.
  - b. The alarm bell shall be mounted directly to the battery/charger unit and connected to sound when any alarm pushbutton or stop switch in the car enclosure is operated.
  - c. The bell shall be configured to operate from power supplied by the building emergency power generator.
2. Provide a new common alarm bell located in the elevator pit.
  - a. The bell shall be configured to operate when the alarm or stop switch of any elevator is activated, during both normal and battery back-up power conditions.
  - b. Existing common alarm bells may be rehabilitated and reused providing they meet the intent of this section and applicable codes.

**PART 3 - EXECUTION**

**3.1 PRE-APPROVED EQUIPMENT MANUFACTURERS**

- A. The following manufacturers' equipment and materials, or equivalent as approved by the Professional, for use on this project. Other equipment not specifically mentioned shall be considered for approval on an individual basis by the Professional.
1. Controller - Smartrise Engineering, GAL Galaxy, ESI Controls.
  2. Tracks, Hangers, Interlocks and Door Operators – Peellee, Courion.
  3. Fixtures - G.A.L., EPCO, Monitor, C.E. Electronics, Innovation, PTL.
  4. Door Protective Device - Janus, G.A.L., T.L. Jones, Tri-Tronics.
  5. Entrances/Entrance Door Panels - EDI/ECI, EMCO, SmartTork.
  6. Machines - Torin Drive International, Hollister-Whitney

7. Motors and Motor Generators - Torin, Imperial Electric, General Electric, Baldor, Reuland.
8. VVVF Power Drives - Mitsubitsi, MagneTek, Yaskawa.
9. Guide Rails - AFD Industries.
10. Electrical Traveling Cables – Draka.
11. Guide Shoes/Rollers – ELSCO.
12. Wire Ropes - Paulsen, Bethlehem, Alps, Draka.

### 3.2 INSPECTION BY THE PROFESSIONAL

- A. Study the Contract Documents with regard to the work as specified and required so as to ensure its completeness.
- B. Examine surface and conditions to which this work is to be attached or applied and notify the Professional in writing, via an RFI in eBuilder, if conditions or surfaces are detrimental to the proper and expeditious installation of the work. Starting the work shall imply acceptance of the surfaces and conditions to perform the work as specified.
- C. Verify, by measurements at the job site, dimensions affecting the work. Bring field dimensions which are at variance with those on the accepted shop drawings to the attention of the Professional. Obtain the decision regarding corrective measures before the start of fabrication of items affected.
- D. Cooperate in the coordination and scheduling of the work of this section with the work of other sections so as not to delay job progress.

### 3.3 INSTALLATION

- A. Modernize the elevators, using skilled workmen in strict accordance with the final accepted shop drawings and other submittals.
- B. Comply with the code, manufacturer's instructions and recommendations.
- C. Coordinate work with the work of other building functions for proper time and sequence to avoid delays and to ensure right-of-way of system. Use lines and levels to ensure dimensional coordination of the work.
- D. Accurately and rigidly secure supporting elements within the shaftways to the encountered construction within the tolerance established.
- E. Provide and install motors, switches, controls, safety and maintenance and operating devices in strict accordance with the submitted wiring diagrams and applicable codes and regulations having jurisdiction.
- F. After installation, touch up in the field, surfaces of shop primed elements which have become scratched or damaged.
- G. Lubricate operating parts of system as recommended by the manufacturer.

### 3.4 PROTECTION AND CLEANING

- A. Adequately protect surfaces against accumulation of paint, mortar, mastic and disfiguration or discoloration and damage during shipment and installation.

- B. Upon completion, remove protection and thoroughly clean work and have it free from discoloration, scratches, dents and other surface defects.
- C. The finished installation shall be free of defects. Before final completion and acceptance of the building, repair and/or replace defective work, to the satisfaction of the Department and the Professional, at no additional cost.

### 3.5 BARRICADES AND HOISTWAY SCREENING

- A. The Contractor shall provide whatever barricades are necessary in order to maintain adequate protection of areas in which work specified by the Contract Documents is being performed, including open hoistway entrances. Fabrication and erection as all barricades shall be in compliance with applicable OSHA regulations.
- B. As required, the Contractor shall provide temporary wire mesh screening in the hoistway and of any elevator undergoing work specified in the Contract Documents. This screening shall be installed in such a manner as to completely segregate the hoistway from that of adjacent elevators. Screening shall be constructed from .041" diameter wire in a pattern that rejects passage of a 1" diameter ball.

### 3.6 PERFORMANCE AND OPERATING REQUIREMENTS

- A. Passenger elevators shall be adjusted to meet the following performance requirements:
  - 1. Speed: within 5% of rated speed under any loading condition.
  - 2. Leveling: within 1/4" under any loading condition.
- B. Maintain the following ride quality requirements for the freight elevator:
  - 1. Horizontal accelerations, peak to peak shall not exceed 18 milli g in the frequency range of 1 to 10 Hz.
  - 2. Amplitude of acceleration and deceleration shall not exceed 4 feet per second, per second. A sustained jerk shall not be more than twice the acceleration. The rate of change in the acceleration/deceleration rate shall not be more than 8.0 ft/sec.<sup>3</sup>.

### 3.7 INSPECTIONS

- A. Upon completion of the work phase for the elevator modernization specified herein, the Contractor shall, at its own expense, arrange and assist with whatever inspections that are required by the L&I Elevator Division.

### 3.8 ACCEPTANCE TESTING

- A. The Contractor shall provide at least five (5) days prior written notice to the Department and the Professional regarding the exact date on which work specified in the Contract Documents will reach completion on any single unit of vertical transportation equipment. In addition to conducting whatever testing procedures may be required by local inspecting authorities in order to gain approval of the completed work, and before seeking approval of said work by the Department and the Contractor shall perform certain other tests in the presence of the Professional. To that end, the Contractor shall provide test instruments, test weights, and qualified field labor as required to safely operate the elevator under load conditions that vary from empty car to full rated load and, in so doing, to successfully demonstrate compliance with applicable performance standards set forth in the project specifications with regard to:

1. Sustained high-speed velocity of the elevator in either direction of travel;
2. Brake-to-brake running time between adjacent floors;
3. Floor leveling accuracy;
4. Ride quality inside the elevator car;
5. Load settings at which anti-nuisance, load dispatch, and load non-stop features are activated.

B. Upon completion of work specified in the Contract Documents on the last car in any group of elevators, and in conjunction with the aforementioned testing procedures, the Contractor shall carry out additional testing of group dispatch/supervisory control features in the presence of the Professional. To that end, the Contractor shall provide test instruments and qualified field labor as required to successfully demonstrate:

1. The back-up operating mode for group dispatch failure;
2. Simulated and actual emergency power operation;
3. Restricted access security features;
4. Zoning operations and floor parking assignments;
5. Up/down peak operation;
6. Response to corridor calls that fall into the "long-wait" category;
7. Lobby dispatch operations.

### 3.9 SUBSTANTIAL COMPLETION

A. The work shall be deemed "Substantially Complete" for an individual unit or group of units when, in the opinion of the Professional, the unit is complete, such that there are no material and substantial variations from the Contract Documents, and the unit is fit for its intended purpose.

1. Governing authority testing shall be completed and approved in conjunction with inspection for operation of the unit; a certificate of operation or other required documentation issued; and remaining items mandated for final acceptance completion are limited to minor punch list work not incorporating any life safety deficiencies.
2. The issuance of a substantial completion notification shall not relieve the Contractor from its obligations hereunder to complete the work.
3. Final completion cannot be achieved until all deliverables, including but not limited to training, spare parts, manuals, and other documentation requirements, have been completed.

END OF SECTION 142003

## SECTION 210500

### COMMON WORK RESULTS FOR FIRE-SUPPRESSION

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. This Section includes the following basic fire-suppression materials and methods to complement other Division 21 Sections.
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Dielectric fittings.
  - 3. Flexible connectors.
  - 4. Equipment nameplate data requirements.
  - 5. Labeling and identifying fire-suppression systems and equipment.
  - 6. Field-fabricated metal equipment supports.
  - 7. Installation requirements common to equipment specification sections.
  - 8. Cutting and patching.
  - 9. Painting - Touchup and finishing.
- B. Pipe and pipe fitting materials are specified in Division 21 piping system Sections.

##### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. References to "GC", "General Contractor" shall refer to the .1 Contractor.

- G. References to "Substantial Completion" shall be taken to mean the date of the Final Inspection by the Professional.
- H. References to "Architect", "Engineer", "Architect / Engineer" and similar terms shall be taken to mean the Professional.
- I. References to "Client Agency" shall be taken to mean the Department and Client Agency, as applicable.
- J. References to "HC", "Heating Contractor", "HVAC Contractor", and "Mechanical Contractor" shall refer to the .2 Contractor performing the work of Division 23.
- K. References to "PC", "Plumbing Contractor" shall refer to the .3 Contractor performing the work of Division 22.
- L. References to "FC", "FPC", "Sprinkler Contractor", and "Fire Protection Contractor" shall refer to the .3 Contractor performing the work of Division 21.
- M. References to "EC" and "Electrical Contractor" shall refer to the .4 Contractor performing the work of Divisions 26, 27, and 28.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For dielectric fittings, flexible connectors, and firestopping materials.
- B. Shop Drawings: Detail fabrication and installation for metal supports and anchorage for fire-suppression materials and equipment.
- C. Coordination Drawings: Detail major elements, components, and systems of equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
  - 1. Planned piping layout, including valve and specialty locations and valve-stem movement.
  - 2. Clearances for installing and maintaining insulation.
  - 3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
  - 4. Equipment and accessory service connections and support details.
  - 5. Exterior wall and foundation penetrations.
  - 6. Fire-rated wall and floor penetrations.
  - 7. Sizes and location of required concrete pads and bases.
  - 8. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
  - 9. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
  - 10. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

#### 1.5 QUALITY CONTROL

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."



- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Fire-suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.

#### 1.7 SEQUENCING AND SCHEDULING

- A. Schedule and arrange water supply flow test at the site facility to obtain the current AND accurate water supply flow and pressure characteristics necessary to adequately design and size the new fire protection system for the new building facility.
- B. Coordinate fire-suppression equipment installation with other building components.
- C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for fire-suppression installations.
- D. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- E. Sequence, coordinate, and integrate installations of fire-suppression materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- F. Coordinate connection of fire-suppression systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors if fire-suppression items requiring access are concealed behind finished surfaces.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Dielectric Unions:
  - a. Capitol Manufacturing Co.
  - b. Central Plastics Co.
  - c. Eclipse, Inc.; Rockford-Eclipse Div.
  - d. Epcos Sales Inc.
  - e. Hart Industries International, Inc.
  - f. Watts Industries, Inc.; Water Products Div.
  - g. Zurn Industries, Inc.; Wilkins Div.
  - h. Or equal as approved by the Professional.
2. Dielectric Flanges:
  - a. Capitol Manufacturing Co.
  - b. Central Plastics Co.
  - c. Epcos Sales Inc.
  - d. Watts Industries, Inc.; Water Products Div.
  - e. Or equal as approved by the Professional.
3. Dielectric-Flange Insulating Kits:
  - a. Calpico, Inc.
  - b. Central Plastics Co.
  - c. Or equal as approved by the Professional.
4. Dielectric Couplings:
  - a. Calpico, Inc.
  - b. Lochinvar Corp.
  - c. Or equal as approved by the Professional.
5. Dielectric Nipples:
  - a. Grinnell Corp.; Grinnell Supply Sales Co.
  - b. Perfection Corp.
  - c. Victaulic Co. of America.
  - d. Or equal as approved by the Professional.
6. Metal, Flexible Connectors:
  - a. Central Sprink, Inc.
  - b. Flexicraft Industries.
  - c. Flex-Weld, Inc.
  - d. Grinnell Corp.; Grinnell Supply Sales Co.
  - e. Hyspan Precision Products, Inc.

- f. McWane, Inc.; Tyler Pipe; Gustin-Bacon Div.
- g. Metraflex Co.
- h. Or equal as approved by the Professional.

7. Fire-Stopping:

- a. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
- b. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
- c. "RTV 7403"; General Electric Co.
- d. Or equal as approved by the Professional.

8. Fire-Stop Pipe Sleeves:

- a. Pipe Shields, Inc.
- b. Pro-Set, Inc.
- c. Or equal as approved by the Professional.

2.2 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- E. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
  - 1. Sleeve: ASTM A 126, Class B, gray iron.
  - 2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
  - 3. Gaskets: Rubber.
  - 4. Bolts and Nuts: AWWA C111.
  - 5. Finish: Enamel paint.

## 2.4 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 150-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Provide separate companion flanges and steel bolts and nuts for 150-psig minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 150-psig minimum working pressure at 225 deg F.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 150-psig minimum working pressure at 225 deg F.

## 2.5 FLEXIBLE CONNECTORS

- A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
  - 1. 2-Inch NPS and Smaller: Threaded.
  - 2. 2-1/2-Inch NPS and Larger: Flanged.
- B. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

## 2.6 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
  - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psig, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## 2.7 FIRE-STOPPING

- A. Fire-Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around piping penetrations through walls and floors, having fire-resistance ratings equal to or greater than adjacent construction and as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc.
- B. Fire-Stop Pipe Sleeves: At the option of the Contractor and if approved by local codes, prefabricated fire-stop pipe sleeves also may be utilized. Pipe sleeves shall be UL Listed and tested in accordance with ASTM E 814. Sleeves shall be adjustable and shall be filled with ceramic fiber material to provide insulation and fire stopping. Sleeves shall provide a 2-hour fire rating.

## 2.8 CEILING, WALL, CHASE, AND SHAFT ACCESS PANELS

- A. The Division 21 Contractor shall provide factory-fabricated access panels (i.e. doors) for access to concealed dampers, valves and other equipment provided under Division 21 where no other means of access is available. Panels are generally not shown on the Drawings for clarity purposes only. The Division 21 Contractor shall review the architectural documents for where inaccessible ceilings are located.
- B. Flush Access Doors:
  - 1. Material: 18 Ga Satin Coat Steel.
  - 2. Door: 18 ga satin coat steel. Recessed design fitted with 5/8 inch thick drywall as finished face.
  - 3. Frame: 18 ga satin coat steel. Press bent for strength and rigidity; drywall taping bead flange.
  - 4. Gasket: Silicone perimeter seal gasket.
  - 5. Hinge: Continuous piano hinge.
- C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Acudor Products, Inc.
  - 2. Castle Access Panels & Forms, inc.
  - 3. Or equal as approved by the Professional.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 21 piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Due to the small scale of the drawings, it is not practical to indicate offsets, fittings, valves or similar items, to make a complete operating system. The drawings are generally diagrammatic and indicative of the work to be installed. The Contractor shall carefully investigate conditions affecting his work and shall install his work in such a manner that

interference between pipes, conduit, ducts, equipment, architectural and structural features will be avoided and shall furnish and install such offsets or fittings to meet the conditions at the building, so as to avoid interference without additional cost to the Client Agency.

- C. Install piping at indicated or required slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- J. Install fittings for changes in direction and branch connections.
- K. Install couplings according to manufacturer's written instructions.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials.
- M. Verify final equipment locations for roughing-in.
- N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- O. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
  - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  - 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  - 3. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
    - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
    - c. Align threads at point of assembly.
    - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
    - e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
  - 4. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

- P. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
  2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
  3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Client Agency.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install fire-suppression equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment giving right of way to piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

### 3.3 PAINTING AND FINISHING

- A. Painting of fire protection systems, equipment, and components is specified in Division 09. In the event of a direct conflict between the provisions of Division 09, and this Section, Division 09 shall take precedence.
- B. Painting in non-finished areas shall be by the FPC. Painting exposed items in finished spaces shall be by the GC.
- C. Do not paint (or permit the General Contractor to paint) piping specialties, grooved couplings and fittings, and similar items with factory-applied finish. Do not paint bronze or copper materials. Do not paint fastener threads (except on pipe hangers and threaded rods), nameplates, identification devices and labels, flexible connectors, vibration control devices, meters and gauges, listed and labeled (e.g. UL) equipment and materials, and any items for which the proper function and/or longevity will be compromised by the application of paint.
- D. Apply protection / masking to items that shall not receive paint prior to paint surface preparation and painting. Coordinate and schedule this work with the General Contractor who is performing

finish painting. Any damage to Division 21 work due to a failure to mask items that should not have been painted shall be replaced and repaired at no additional cost to the Client Agency. The GC shall remove the masking prior to painting.

- E. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish. Marred finishes on items exposed to view in finished spaces shall be replaced with new items when the severity of the damage or quality of the finish repair is judged to be unacceptable by the Architect or Engineer.
- F. At locations where it is necessary to cut and patch existing construction to perform Division 21 work, painting at each location shall be performed by the Division 21 Contractor. New finishes shall match existing finishes. Comply with the provisions of Division 09.
- G. Refer to Division 09 Section "Painting - Exterior and Interior" for paint materials, surface preparation, and application of paint. Paint all exposed fire protection lines "Red" unless otherwise directed by the Professional.
- H. Refer to Division 21 Section "Fire Protection System Identification" for fire protection color schemes.
- I. Apply paint to exposed piping according to the following, unless otherwise indicated:
  - 1. Interior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
  - 2. Interior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
  - 3. Interior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
  - 4. Exterior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
  - 5. Exterior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
  - 6. Exterior, Galvanized-Steel Supports: Use semi-gloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
- J. Do not paint piping specialties with factory-applied finish.
- K. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials, piping, ductwork and equipment.
- C. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."
- D. Structural steel members installed at the exterior of the building or in damp or wet locations shall be hot dipped galvanized after fabrication. Conform to ASTM A123. Where exterior structural steel members are cut, drilled or welded, or galvanizing is damaged, repair with a cold galvanizing repair compound with dry film containing not less than 93 percent zinc dust by



weight, and complying with DOD-P-21035A or SSPC-Paint 20, as manufactured by ZRC Products Company, or equivalent.

### 3.5 CUTTING AND PATCHING

- A. The Division 21 Contractor shall include in his bid all cutting and patching work required for the fire protection demolition and installation of fire protection work performed under Division 21, unless otherwise noted or that is not explicitly addressed on the Architectural/Structural documents. Any damage incident to cutting or other causes in the performance of the contract work shall be made good by replacement or repairs in a manner satisfactory to the Architect/Engineer.
- B. Where piping, ducts, or other equipment pass through fire or smoke rated construction, furnish and install sleeves and thoroughly seal openings around sleeves, pipes, ducts, etc. With fire and smoke resistant materials. Materials shall be provided to maintain the fire rating of the adjacent construction in accordance with the requirements of NFPA and other applicable codes.
- C. No structural members shall be cut without prior approval of the Architect. Generally, any interior opening greater than 8 inches in diameter will need to be framed out/finished by the GC.
- D. The GC will perform all cutting of the roof and exterior walls. Coordinate with the GC for exact locations, size of openings, etc.
- E. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- F. Repair cut surfaces to match adjacent surfaces.
- G. Patching after fire protection demolition:
  - 1. Penetrations through interior walls and floors: Unless otherwise noted, the fire protection contractor shall be responsible for patching all remaining openings in the interior walls, floors, and ceilings.
  - 2. Unless otherwise noted, the general contractor shall be responsible for patching, etc., of all remaining openings through exterior walls.
  - 3. Patching of the roof deck will be by the .1 contractor. Patching of the roof deck of all remaining openings shall be by the fire protection contractor unless specifically shown to be patched/repared on the architectural or structural drawings by the .1 contractor.

### 3.6 GROUTING

- A. Install nonmetallic, nonshrink, grout for fire-suppression equipment base bearing surfaces, equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout on concrete bases to provide smooth bearing surface for equipment.

- F. Place grout around anchors.
- G. Cure placed grout according to manufacturer's written instructions.

### 3.7 CONCRETE EQUIPMENT BASES

- A. Indoor Concrete Housekeeping Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Base slabs under housekeeping equipment pads shall be cleaned and scarified, then prepared with a bonding agent, before pouring the equipment base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
    - a. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - b. Anchor bolts for equipment shall be placed when pad is being poured.
    - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
    - d. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 4. Use 4000-psi, 28-day compressive-strength concrete and reinforcement as specified in the Division 03 Section "Cast-in-Place Concrete."
  - 5. Edges shall be provided with a 3/4" chamfer.

### 3.8 CONCRETE WORK

- A. Scope: Provide concrete work related to new and repair work included under this Division. Construct concrete forms and equipment pads / bases for the new floor- or grade-mounted equipment installed under this Division. Pads and forms shall be of suitable dimensions for all equipment.
- B. Comply with the provisions of Division 03. Concrete work shall be constructed subject to the approval of the Architect / Engineer.

END OF SECTION 210500

## SECTION 210518

### ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes: Escutcheons and Floor Plates for Fire Protection systems.
  - 1. Escutcheons.
  - 2. Floor plates.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### PART 2 - PRODUCTS

##### 2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

##### 2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish; or one-piece, stamped-steel type.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish; or one-piece, stamped-steel type.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish; one-piece, stamped-steel type.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated rough-brass finish; or one-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: One-piece, floor-plate type.

### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 210518

## SECTION 210523

### GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Iron butterfly valves with indicators.
  - 2. Check valves.
  - 3. Iron OS&Y gate valves.
  - 4. NRS gate valves.

##### 1.3 DEFINITIONS

- A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- B. NRS: Nonrising stem.
- C. OS&Y: Outside screw and yoke.
- D. SBR: Styrene-butadiene rubber.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, and weld ends.
  - 3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.

2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
1. Main Level: HAMV - Fire Main Equipment.
    - a. Level 1: HLOT - Valves.
      - 1) Level 3: HLUG - Ball Valves, System Control.
      - 2) Level 3: HLXS - Butterfly Valves.
      - 3) Level 3: HMER - Check Valves.
      - 4) Level 3: HMRZ - Gate Valves.
  2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
    - a. Level 1: VQGU - Valves, Trim and Drain.
- B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
1. Automated Sprinkler Systems:
    - a. Indicator posts.
    - b. Valves.
      - 1) Gate valves.
      - 2) Check valves.
        - a) Single check valves.
      - 3) Miscellaneous valves.
- C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.
- D. ASME Compliance:
1. ASME B16.1 for flanges on iron valves.
  2. ASME B1.20.1 for threads for threaded-end valves.
  3. ASME B31.9 for building services piping valves.
- E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

- F. NFPA Compliance: Comply with NFPA 24 for valves.
- G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valve Actuator Types:
  - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
  - 2. Handwheel: For other than quarter-turn trim and drain valves.
  - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

## 2.2 IRON BUTTERFLY VALVES WITH INDICATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Globe Fire Sprinkler Corporation.
  - 2. Kennedy Valve Company; a division of McWane, Inc.
  - 3. NIBCO INC.
  - 4. Victaulic Company.
  - 5. Zurn Industries, LLC.
  - 6. Or equal as approved by the Professional.
- B. Description:
  - 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
  - 4. Seat Material: EPDM.
  - 5. Stem: Stainless steel.
  - 6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
  - 7. Actuator: Worm gear or traveling nut.
  - 8. Supervisory Switch: Internal or external.
  - 9. Body Design: Grooved-end connections.

## 2.3 CHECK VALVES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Globe Fire Sprinkler Corporation.
  - 2. Kennedy Valve Company; a division of McWane, Inc.
  - 3. Mueller Co.
  - 4. NIBCO INC.
  - 5. Reliable Automatic Sprinkler Co., Inc. (The).
  - 6. Victaulic Company.
  - 7. Or equal as approved by the Professional.

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

## 2.4 IRON OS&Y GATE VALVES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hammond Valve.
2. Kennedy Valve Company; a division of McWane, Inc.
3. Mueller Co.
4. NIBCO INC.
5. Victaulic Company.
6. Watts; a Watts Water Technologies company.
7. Zurn Industries, LLC.
8. Or equal as approved by the Professional.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged, Grooved or Threaded.

## 2.5 NRS GATE VALVES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kennedy Valve Company; a division of McWane, Inc.
2. Mueller Co.
3. NIBCO INC.
4. Victaulic Company.
5. Zurn Industries, LLC.
6. Or equal as approved by the Professional.



B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged, Grooved or Threaded.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

- A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
  1. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.
- H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.
- I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION 210523

## SECTION 210529

### HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING SYSTEMS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes NFPA 13 requirements for fire-suppression piping system installations.

##### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

##### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details, and include calculations.

##### 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## 1.7 QUALITY CONTROL

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Pipe Hangers:
    - a. Anvil International.
    - b. Modern Pipe Supports Corp.
    - c. National Pipe Hanger Corp.
    - d. Or equal as approved by the Professional.
  - 2. Channel Support Systems:
    - a. Allied Tube Conduit.
    - b. Anvil International.
    - c. Cooper B-Line, Inc. a division of Cooper Industries.
    - d. Flex-Strut Inc.
    - e. Unistrut; an Atkore International Company.
    - f. Or equal as approved by the Professional.
  - 3. Powder-Actuated Fastener Systems:
    - a. Hilti Corporation.
    - b. ITW Ramset.
    - c. MKT Fastening.
    - d. Or equal as approved by the Professional.

### 2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Installations" Article in Part 3 for installation requirements.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
  - 1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated. All channel support systems and accessories exposed to weather shall be hot-dipped galvanized, no exceptions.
  - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

## 2.3 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized. All structural steel members, plates, shapes, and bars exposed to weather shall be hot-dipped galvanized, no exceptions.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  - 2. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 3. Design Mix: 5000-psi, 28-day compressive strength.

## 2.4 HANGERS, BRACING, AND RESTRAINT OF SYSTEM PIPING

- A. The following information is in part from NFPA 13-2010. Refer to NFPA 13-2010, Chapter 9, Article 9.1 for additional component requirements, tables, and appendix information for hangers and support applications.

### "9.1 Hangers

#### 9.1.1\* General.

- 9.1.1.1 Unless the requirements of 9.1.1.2. are met, types of hangers shall be in accordance with the requirements of Section 9.1.

- 9.1.1.2 Hangers certified by a registered professional engineer to include all of the following shall be an acceptable alternative to the requirements of Section 9.1:

- (1) Hangers shall be designed to support five times the weight of the water-filled pipe plus 250 lb. at each point of piping support.
- (2) These points of support shall be adequate to support the system.
- (3) The spacing between hangers shall not exceed the value given for the type of pipe as indicated in Table 9.2.2.1(a) or Table 9.2.2.1(b).
- (4) Hanger components shall be ferrous.
- (5) Detailed calculations shall be submitted, when required by the reviewing authority, showing stresses developed in hangers, piping, and fittings and safety factors allowed.

- 9.1.1.3 Where water-based fire protection systems are required to be protected against damage from earthquakes, hangers shall also meet the requirements of 9.3.7."

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATIONS

- A. The following information is in part from NFPA 13-2010. Refer to NFPA 13-2010, Chapter 9, Article 9.2 for additional installation requirements, and appendix information for hangers and support installations.

#### "9.2 Installation of Pipe Hangers

##### 9.2.1 General.

##### 9.2.1.1 Ceiling Sheathing.

9.2.1.1.1\* Unless the requirements of 9.2.1.1.2 are met, sprinkler piping shall be supported independently of the ceiling sheathing.

9.2.1.1.2 Toggle hangers shall be permitted only for the support of pipe 1-1/2" or smaller in size under ceilings of hollow tile or metal lath and plaster.

##### 9.2.1.3\* Building Structure.

9.2.1.3.1 Unless the requirements of 9.2.1.3.3 apply, sprinkler piping shall be substantially supported from the building structure, which must support the added load of the water-filled pipe plus a minimum of 250 lb. applied at the point of hanging, except where permitted by 9.2.1.1.2, 9.2.1.3.3, and 9.2.1.4.1.

9.2.1.3.2 Trapeze hangers shall be used where necessary to transfer loads to appropriate structural members.

##### 9.2.1.3.3\* Flexible Sprinkler Hose Fittings.

9.2.1.3.3.1 Listed flexible sprinkler hose fittings and their anchoring components intended for use in installations connecting the sprinkler system piping to sprinklers shall be installed in accordance with the requirements of the listing, including any installation instructions.

9.2.1.3.3.2 When installed and supported by suspended ceilings, the ceiling shall meet ASTM C 635, *Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings*, and shall be installed in accordance with ASTM C636, *Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels*.

9.2.1.3.3.3\* Where flexible sprinkler hose fittings exceed 6 feet in length and are supported by a suspended ceiling in accordance with 9.2.1.3.3.2, a hanger(s) attached to the structure shall be required to ensure that the maximum un-supported length does not exceed 6 feet.

9.2.1.3.3.4\* Where flexible sprinkler hose fittings are used to connect sprinklers to branch lines in suspended ceilings, a label limiting relocation of the sprinkler shall be provided on the anchoring component.

- 9.2.1.3 Metal Deck.
- 9.2.1.4.1\* Branch line hangers attached to metal deck shall be permitted only for the support of pipe 1 inch or smaller size, by drilling or punching the vertical portion of the metal deck and using through bolts.
- 9.2.1.4.2 The distance from the bottom of the bolt hole to the bottom of the vertical member shall be not less than 3/8".
- 9.2.1.5 Where sprinkler piping is installed below ductwork, piping shall be supported from the building structure or from the ductwork supports, provided such supports are capable of handling both the load of the ductwork and the load specified in 9.2.1.3.1."

### 3.2 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

### 3.3 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 210529

## SECTION 210553

### IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes: Identification signs, labels, and tags for fire protection systems.
  - 1. Pipe labels.
  - 2. Valve tags.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve Schedules: For each piping system, include a listing of all valves labeled and tagged with a coordinated numbering scheme. Reproduce the schedule on standard-size bond paper. Tabulate valve identification list with tag numbers, system type and abbreviations as shown on the valve tags with the specific building area or room location included. Include special notes and references to specific or special valve variations, functions, operations, maintenance, and emergency services or shutdown procedures. Besides providing a mounted enclosed framed copies in the Maintenance Office area, furnish copies for the maintenance manuals.
- D. Valve numbering scheme: Numbering of valves shall be in sequence with each system labeled and identified separately and differently.

#### PART 2 - PRODUCTS

##### 2.1 PIPE LABELS

- A. Piping Identification Labels.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Brimar Industries, Inc.



2. Craftmark Pipe Markers.
  3. Marking Services Inc.
  4. Seton Identification Products.
  5. Or equal as approved by the Professional.
- C. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.
- D. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: Size letters according to ASME A13.1 for piping and at least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
- G. Pipe-Label Colors:
1. Background Color: Safety Red.
  2. Letter Color: White.

## 2.2 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Brimar Industries, Inc.
  2. Craftmark Pipe Markers.
  3. Marking Services Inc.
  4. Seton Identification Products.
  5. Or equal as approved by the Professional.
- B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers.
1. Tag Material: Brass, 0.032-inch, stainless steel, 0.025-inch or aluminum, 0.032-inch minimum thickness, and having predrilled or stamped 5/32 inch hole for attachment hardware.
  2. Tag Shape and Size: Round – 2" diameter minimum.
  3. Fasteners: Stainless Steel small-link chain or S-hook.
  4. Valve-Tag Color: Safety Red.
  5. Letter Color: White.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or

space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall include operation and maintenance data.
  2. Valve Schedule Display Glazed Framing: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Extruded aluminum frame with AS ASTM C 1036, Type I, Class 1, Glazing quality B, 2.5-mm, single-thickness glass protective glazing. Include mounting hardware and screws.
- D. Access Panel Markers: 1/16-inch- thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 1/8-inch center hole for attachment.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### 3.3 PIPE LABEL INSTALLATION

- A. Piping: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
  2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations and on through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit a view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

- C. Pipe Label Color Schedule:
  - 1. Fire Protection Piping:
    - a. Background: Safety red or white.
    - b. Letter Colors: White or Red.
- D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

#### 3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.
- B. Provide a complete, coordinated valve tagging system shall be provided for all new valves throughout the building.
- C. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
  - 1. Valve-Tag Size and Shape:
    - a. Fire-Suppression Service: 2 inches, round.
    - b. Wet-Pipe Sprinkler System: 2 inches, round.

END OF SECTION 210553

## SECTION 211313

### WET-PIPE SPRINKLER SYSTEMS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipes, fittings, and specialties.
  - 2. Sprinklers.
  - 3. Alarm devices.

##### 1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 250 psig maximum.

##### 1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

##### 1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 250-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
  - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
  - 2. Sprinkler Occupancy Hazard Classifications:
    - a. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - b. General Storage Areas: Ordinary Hazard, Group 1.

- c. Office and Public Areas: Light Hazard.
- 3. Minimum Density for Automatic-Sprinkler Piping Design:
  - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
  - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
- 4. Maximum Protection Area per Sprinkler: Per UL listing.
- 5. Maximum Protection Area per Sprinkler:
  - a. Office and Public Areas: 225 sq. ft..
  - b. Storage Areas: 130 sq. ft..
  - c. Electrical Equipment Rooms: 130 sq. ft..
  - d. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
  - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
  - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

#### 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Domestic water piping.
  - 2. Items penetrating finished ceiling include the following:
    - a. Lighting fixtures.
- E. Qualification Data: For qualified Installer and professional engineer.
- F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- G. Welding certificates.
- H. Fire-hydrant flow test report.
- I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

- J. Field quality-control reports.
- K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

## 1.7 QUALITY CONTROL

- A. Installer Qualifications:
  - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."

## 1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

## 1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

## 2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type F, Grade A. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 4 and smaller.
- C. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- E. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 250, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 250.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anvil International, Inc.
    - b. National Fittings, Inc.
    - c. Tyco Fire & Building Products LP.
    - d. Victaulic Company.
    - e. Or equal as approved by the Professional.
  - 2. Pressure Rating: 250 psig minimum.
  - 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

## 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
  - 1. Class 250, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

## 2.4 SPRINKLER SPECIALTY PIPE FITTINGS

### A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. National Fittings, Inc.
  - b. Tyco Fire & Building Products LP.
  - c. Victaulic Company.
  - d. Or equal as approved by the Professional.
2. Standard: UL 213.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

### B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AGF Manufacturing Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
  - e. Or equal as approved by the Professional.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

## 2.5 SPRINKLERS

### A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Victaulic Company.



4. Viking Corporation.
5. Or equal as approved by the Professional.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6 (8.0 for Ordinary Hazard, Group 1 areas), and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch (25-mm) vertical adjustment.

## 2.6 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Potter Electric Signal Company.
  - b. System Sensor; a Honeywell company.
  - c. Viking Corporation.
  - d. Or equal as approved by the Professional.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

C. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Potter Electric Signal Company.
  - b. System Sensor; a Honeywell company.
  - c. Or equal as approved by the Professional.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- E. Install sprinkler piping with drains for complete system drainage.
- F. Install alarm devices in piping systems.
- G. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- H. Fill sprinkler system piping with water.
- I. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire- Suppression Piping."

- J. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- K. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire- Suppression Piping."

### 3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.4 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

### 3.5 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Coordinate with fire-alarm tests. Operate as required.
  - 5. Verify that equipment hose threads are same as local fire-department equipment (double start Roxbury cut).
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.7 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

### 3.8 DEMONSTRATION

- A. Train Client Agency's maintenance personnel to adjust, operate, and maintain specialty valves.

### 3.9 PIPING SCHEDULE

- A. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
  - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:
  - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  - 2. Standard-weight, black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 3. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.10 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
  - 1. Rooms with Suspended Ceilings: Quick response semi-recessed pendent sprinklers.
  - 2. Rooms or Areas without Suspended Ceilings: Upright sprinklers.
  
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
  - 1. Concealed Sprinklers: Bright chrome, with escutcheon and cover color to match ceiling color.
  - 2. Upright and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

END OF SECTION 211313

## SECTION 230500

### COMMON WORK RESULTS FOR HVAC

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 ADDITIONAL RELATED SECTIONS

- A. In the event of a direct conflict with the requirements of this Section and of those contained in Divisions 01, 02, 03, 05, 07, 08, 09, or 26, the requirements of those other Divisions shall take precedence, but only if they are more demanding or restrictive.

##### 1.3 SUMMARY

- A. This Section includes provisions that apply to Division 23 work in its entirety.

- B. This Section includes the following:

- 1. General Project Requirements

- a. Definitions
    - b. General Project Coordination and Planning
      - 1) Coordination between Division 23 and Division 26
      - 2) Coordination with the Commissioning Agent
    - c. HVAC System Commissioning
    - d. Delivery, Storage, and Handling
    - e. Sequencing and Scheduling
    - f. Interpretation of the Documents

- 2. Extra Materials

- 3. Escutcheons

- 4. Fire- and smoke-stopping materials and systems

- 5. Mechanical sleeve seals

- 6. Non-shrink grout for base mounted equipment installations

- 7. Materials used in air plenums.

- 8. Field-fabricated metal equipment supports

- 9. Equipment installation requirements common to equipment specification sections

- 10. Ceiling, wall, and shaft access panels

- 11. Control wiring

- 12. Motor controllers and disconnect switches

- 13. Construction during occupancy

- 14. HVAC demolition

15. Cutting and patching
16. Installation of work on the roof
17. Concrete equipment bases
18. Painting and finishing
19. AC condensate drain piping

#### 1.4 DEFINITIONS

- A. Atmosphere: Outside the exterior walls and roof of a building.
- B. Finished Spaces: Areas where drywall is hung or installed with wall coverings and/or painted; or where floors are polished or coverings are installed on the floor; or where the ceiling is plaster/gypsum board and/or suspended acoustic ceiling tile.
- C. Unfinished Space: Spaces other than finished spaces. Typical examples include mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, attics, crawl spaces, garages, and tunnels.
- D. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- E. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- F. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- G. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters or inside equipment enclosures.
- H. Conditioned Space: Spaces within the insulated envelope of the building and provided with both mechanical heating and air conditioning, either directly or indirectly.
  1. Ceiling and floor plenums and ceiling spaces (areas between the finished ceiling and the structural floor or roof slab/deck above) are considered (indirectly) conditioned spaces.
- I. Unconditioned Space: Spaces lacking either mechanical heating or air conditioning, or both, and are outside of the insulated envelope of the building. Examples: Outdoor-air-ventilated crawlspaces and attics.
  1. Mechanical and electrical rooms, and similar spaces, that are only heated and outdoor-air-ventilated, or are only outdoor-air-ventilated, shall be considered unconditioned spaces.
- J. Contractor: The contractor performing the work of the trade drawings or specification division where the use of the term appears, unless a more specific indication is made.
- K. Furnish: Purchase and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar subsequent requirements.
- L. Install: Operations at project site required to place furnished materials and equipment into use, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to

dimension, connecting, finishing, curing, protecting, cleaning, adjusting, commissioning, and similar requirements.

- M. Provide: Both furnish and install.
- N. Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Install items in the same locations or in locations indicated.
- O. Relocate: Same meaning as "reinstall".
- P. Remove: Remove items from their current installed condition and legally dispose of those items, except those indicated to be reinstalled/relocated or salvaged or to remain the Client Agency's property as indicated.
- Q. Demolish: Same meaning as "remove".
- R. Replace: Remove items indicated as defined under "remove" herein and provide new items with matching dimensions, capacities, and all other features in the same location as the items removed, unless explicitly indicated otherwise.
- S. Salvage (and similar terms and phrases such as "Turn Over to Client Agency"): Items indicated to be salvaged shall remain the Client Agency's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Client Agency's designated storage area.
- T. Indicated: The term "indicated", "shown," "noted," "scheduled," and "specified" refers to graphic representations, notes, schedules, or other indications on the Drawings; or to other paragraphs or schedules in the Specifications and other similar requirements in the Contract Documents.
- U. May: Indicative of a Contractor's Option, or that which the Contractor is permitted to do, but not required to do.
- V. Shall: Indicative of a mandatory contract requirement, or that which the Contractor has a duty to perform.
- W. Must: Same meaning as "shall".
- X. Will: Unless explicitly identified as associated with the work of, or performed by, another contractor or under a separate contract, or to be future work also outside this contract, "will" shall be taken to mean the same as "shall", (i.e. representative of a mandatory requirement of this contract).
- Y. The terms "approved", "equal", "acceptable", or "proper" and words of a similar meaning shall be understood to mean "meeting the design intent as determined by the Architect or Engineer".
- Z. The terms "Engineer" and "Architect" used in these specifications are used interchangeably, and refer to the same entities - the design professionals of record.
- AA. "Approved": When used to convey Architect's or Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's or Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- BB. "Directed": A command or instruction by Architect or Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."



- CC. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- DD. References to "GC", "General Contractor" shall refer to the .1 Contractor.
- EE. References to "Substantial Completion" shall be taken to mean the date of the Final Inspection by the Professional.
- FF. References to "Architect", "Engineer", "Architect / Engineer" and similar terms shall be taken to mean the Professional.
- GG. References to "Owner" shall be taken to mean the Department and Client Agency, as applicable.
- HH. References to "HC", "Heating Contractor", "HVAC Contractor", and "Mechanical Contractor" shall refer to the .2 Contractor performing the work of Division 23.
- II. References to "PC", "Plumbing Contractor" shall refer to the .3 Contractor performing the work of Division 22.
- JJ. References to "FC", "FPC", "Sprinkler Contractor", and "Fire Protection Contractor" shall refer to the .3 Contractor performing the work of Division 21.
- KK. References to "EC" and "Electrical Contractor" shall refer to the .4 Contractor performing the work of Divisions 26, 27, and 28.
- LL. Withstand, Resist: With respect to wind resistance ratings, "withstand" and "resist" shall mean to be without permanent deformation of components, fasteners and anchors, and be able to continue to function normally without excessive water or air leakage, without excessive vibration, and meeting all scheduled functional performance requirements, after being subjected to the design wind speed from any direction.
- MM. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

## 1.5 ACTION SUBMITTALS

- A. Product Data: Provide for the following:
  - 1. Mechanical sleeve seals
  - 2. Fire- and smoke-stopping materials
- B. Shop Drawings: Detail fabrication and installation for metal supports and anchorage for HVAC materials and equipment.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Coordination drawings shall be prepared as specified in this Section and as defined in Division 01. Note that the requirements of this Section may be more restrictive and create additional requirements.
  - 1. Refer to the coordination article(s) elsewhere in this Section.

2. No installation of permanent systems shall proceed until the coordination drawings are reviewed by the Architect / Engineer. No additional compensation shall be allowed for changes required to accommodate installation of systems provided under other Divisions of this Contract.
3. Coordination drawings shall be developed from individual system shop drawings and contractor fabrication drawings. Electronic or other reproduced engineering design drawings used as coordination drawings are not acceptable.
4. Coordination drawings shall be initiated by the Contractor responsible for the ductwork installation. That Contractor shall indicate, on the plans, equipment and duct locations and dimensions drawn to scale, taking into consideration and incorporating proper service and access clearances. The drawing shall then be given to the Contractors installing piping, conduit for the inclusion of their work on the coordination drawing. All discrepancies and conflicts with the architectural layout of the building shall be noted on the coordination drawings. The Contractors of the various Divisions shall meet as required to resolve discrepancies with ductwork, piping, and conduit prior and to coordinate those elements on the coordination drawings. The Contractor who initiated the coordination drawings shall submit them for review to the Architect and Engineer. Coordination and installation of work not indicated on the coordination drawing shall be the responsibility of the Contractor responsible for that equipment. Any modifications required by any Contractor for equipment to be installed that is not shown on the coordination drawing shall be the responsibility of the Contractor who failed to indicate that equipment.
  - a. Coordination drawings shall be prepared for each general area, floor level, and roof level and shall be of a scale not less than 1/4 inch per 1 foot. Mechanical and electrical rooms and areas with similar levels of congestion shall be prepared at 1/2 inch per foot.
  - b. Plans and elevations shall be prepared for shafts and chases containing more than one duct or the work of multiple trades at 1/4" per foot.
  - c. Electronic Format: As required by Division 01.
5. Detail major elements, components, and systems of HVAC equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
  - a. Planned ductwork layout, including all duct accessories (dampers, silencers, access doors, etc.) and control devices (airflow measuring stations, sensors, etc.).
  - b. Planned piping layout, including valve and specialty locations, meters and gauges, control devices (control valves, flow meters, sensors, etc.), and valve-stem movement.
  - c. Clearances for installing and maintaining insulation.
  - d. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
  - e. Hangers and supports for ductwork, piping, and equipment, including the size and magnitude of all point loads.
  - f. Access paths through mechanical rooms and on roofs.
  - g. Methods for maintaining required roof slope and roof drainage around rooftop installations.
  - h. Equipment and accessory service connections and support details.
  - i. Sizes and locations of access panels in ceilings, shafts, walls, etc.
  - j. Exterior wall and foundation penetrations.
  - k. Fire- and smoke-rated wall and floor penetrations. Indicate UL directory file number for the fire/smoke stopping system proposed at each penetration.
  - l. Sizes and location of required concrete pads and bases.
  - m. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.

- n. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
  - o. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.
  - p. Requirements for coordination drawings indicated in other Division 23 Sections.
6. Access Panel Schedule: List of sizes, types, locations, and required purpose for all access panels in ceilings, shafts, walls, etc. Coordinate locations of any access panels not indicated on the Architectural Drawings with the Architect prior to installation.

## 1.7 EXTRA MATERIALS

- A. Unless otherwise specified, extra materials (e.g. maintenance material submittals), wherever required by other Division 23 Sections, shall be stored in accordance with the provisions of this paragraph.
- 1. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate).
  - 2. Include copies of relevant installation and operating manuals and contact information for the supplier. Documentation shall be placed in the packaging / storage box.
  - 3. Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in sealed plastic wrapping.
  - 4. Spare parts with individual weights less than 5 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be furnished in cardboard boxes. A neatly type inventory of spare parts shall be placed in a plastic sleeve and taped to the outside of the box.

## 1.8 QUALITY CONTROL

- A. Code Compliance: All aspects of the Contractor's work shall comply with applicable codes.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. Factory Fabricated HVAC Equipment: Of the type, design, and size that manufacturers currently offer for sale and appears in the manufacturer's current catalogue. Equipment shall be new and fabricated from new materials, and shall be free from defects in materials and workmanship.
- D. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- E. Minimum Energy Efficiency: Compressor-containing, fuel fired, and absorption refrigeration equipment shall meet the minimum efficiency requirements listed in the 2018 International Energy Conservation Code and ASHRAE 90.1-2016.

## 1.9 GENERAL PROJECT COORDINATION AND PLANNING

- A. Prior to the ordering of materials or installation of work, coordinate and pre-plan the work to the extent necessary to permit the work to be installed satisfactorily, in accordance with the Contract Documents, and with the least possible interference or delay.
- B. When work is installed without the required coordination and/or planning, changes to the work deemed necessary by the Architect shall be made to correct the conditions without additional cost to the Client Agency.
- C. The Contractor is advised to furnish complete Contract Documents to all suppliers, sub-contractors, and other agents. Information required by those entities for the proper completion of their work in a coordinated fashion with the work of others will typically appear in multiple places in the Contract Documents.
  - 1. Any failure on the part of a suppliers, sub-contractors, and other agents to improperly interpret the Contractor Documents or to understand other requirements made necessary by the coordination and planning process, is the full responsibility of the Contractor.

## 1.10 COORDINATION WITH THE CLIENT AGENCY HIRED COMMISSIONING AGENT

- A. A Commissioning Agent will be hired by the Client Agency for system certification at the completion of construction. The Division 23 Contractor shall assist the Commissioning Agent by supporting tasks as directed by the Agent.
- B. Refer to Division 01 Section 019100 and Division 23 Section 230800 "HVAC Systems Commissioning".
- C. The Division 23 Contractor shall perform their own functional testing and commissioning of the systems as elsewhere detailed in the Division 23 Specifications to verify that the systems are installed in full accordance with the documents and the requirements of the equipment manufacturers, as applicable, prior to the start of work by the Commissioning Agent.

## 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

D. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

F. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.12 SEQUENCING AND SCHEDULING

A. Coordinate HVAC equipment and systems installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for HVAC installations.

C. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

D. Coordinate requirements for access panels and doors if HVAC items such as dampers, valves and other equipment requiring access are concealed behind finished surfaces where no other means of access is available. Provide access panels and doors meeting the applicable requirements of Division 08. Coordinate locations of any access panels not indicated on the Architectural Drawings with the Architect prior to installation.

1.13 INTENT AND REQUIRED INTERPRETATION OF THE CONSTRUCTION DOCUMENTS

A. Provide complete and functional systems for the project. The systems shall conform to the details stated in these Specifications and shown on the Drawings. Items or work not shown or specified, but required for complete systems, shall be provided and conform to accepted trade practices.

B. The Drawings and Specifications are presented to define specific system requirements and serve to expand on the primary contract requirements of providing complete and functional systems. The drawings are diagrammatic and indicate the general arrangement and routing of the systems included in this Contractor's work.

C. Drawings and Specifications are intended to be complementary to each other, and contract required work only may be indicated in one of these two sources. Inclusion of a scope element in either alone, or both, obligates the Contractor to provide the indicated work.

1. References in specific Specification sections to other Sections or to the Drawings are made for the Contractor's convenience only, and the omission of a potential reference shall not be interpreted by the Contractor as invalidating the other (unreferenced) provisions.
- D. All work indicated in the documents shall be completed using new equipment and materials, unless explicitly indicated otherwise.
- E. The Architect / Engineer shall not be responsible for design changes or modifications except as set forth by the Architect / Engineer in writing. The Contractor shall comply with the Contract Documents except as directed in writing or as required by an applicable code or product/equipment manufacturer's instructions. The Contractor shall not proceed based on verbal responses by the Architect / Engineer to questions posed by the Contractor.
- F. Do not scale the Drawings. Because of the small scale and diagrammatic nature of the Drawings, it is not possible to indicate offsets, fittings, valves, piping and duct accessories and appurtenances, or similar items which may be required to provide complete operating systems. Carefully investigate conditions affecting the work associated with this project. Check and verify dimensions and existing conditions at the site. Install systems in such a manner that interferences between pipes, conduit, ducts, equipment, architectural and structural features are avoided. Provide items required to meet the project conditions without additional cost to the Client Agency.
- G. Where the Contractor has been furnished with electronic PDF files of the Drawings or a 3D model that contains layering information (e.g. the PDF has not been "flattened"), that layering information shall be ignored by the Contractor. Obtaining information from the Drawings for purposes of preparing a bid price (i.e. "take offs") shall be performed by inspection of the as-printed presentation of the Drawing information. Any inconsistencies in the layering information that causes the Contractor using such layering information to prepare a faulty bid shall be considered to be at the Contractor's risk.
- H. The Contractor's use of electronic copies of the Contract Documents shall constitute implicit acknowledgement and acceptance of the following conditions:
1. The electronic data is transferred for a specific, limited purpose; any use of the data for other than its originally intended purpose is prohibited.
  2. The Architect / Engineer is the author of the data and retains full rights of authorship in the data and all other rights not specifically conveyed. The electronic data is transferred for the sole benefit of the client for whom the design services have been performed. The recipient may not transmit the information to other parties except for purposes of bidding this project. Use of this material for any other purpose is prohibited without the written permission of the Architect / Engineer.
  3. The recipient acknowledges that the data is being transmitted in electronic form for convenience only and that the signed and sealed hard copies are the only true Contract Documents of record.
  4. The recipient is solely responsible for verifying that the information contained in the electronic data file is identical in all material aspects to the Contract Documents of record.
  5. Use of the electronic data is at the sole risk of the recipient, who acknowledges that the electronic data is subject to undetectable alteration or electronic corruption or degradation.
  6. The recipient is solely responsible for confirming that the information is current and for updating the information to reflect any changes in the design subsequent to the date of receipt of the information.
  7. The recipient indemnifies and holds harmless the Architect for all claims and losses resulting from unauthorized or improper use of the data.
  8. Transfer of the information in electronic form does not convey to the recipient a license to use the software that was used to create the information, nor does it create an obligation on the author's part to provide the software to the recipient.

9. The Architect / Engineer makes no representation or warranty and shall have no liability concerning the operation or performance of the templates or programs, or concerning the accuracy of the data as delivered, or in connection with hardware or any software, any changes made to the electronic materials as delivered, any viruses contained in the materials as delivered, or any other defect or error or alleged defect or error in the materials as delivered.
- I. These documents may not explicitly disclose all final details required for a complete systems installation; however, Contractors shall possess the expertise to include the necessary appointments of complete operating systems in their bid price.
- J. The Contractor shall include in his bid price the cost of all work that is an obvious, logical, or reasonably foreseeable consequence of other work explicitly indicated in the documents.
- K. Damper Quantities: Damper quantities indicated on the Drawings are not explicit. In each location where a life safety damper (e.g. fire, smoke, or combination fire/smoke damper), backdraft damper, or motorized damper is indicated, the Contractor shall provide the quantity of dampers required to meet the indicated performance requirements and completely fill the associated duct, plenum, or opening size. Provide an actuator or operator for each damper, as applicable.
- L. Should a bidding Contractor find conflicts or discrepancies in, or omissions from, the Drawings or Specifications, or should he be in doubt as to their meaning, the bidding Contractor should at once notify the Architect, who will send written instructions to all bidders. If these are ignored by the bidding Contractor, the bidding Contractor will be responsible for furnishing the proper or workable equipment as deemed necessary by the Architect / Engineer. The same shall apply to conflicts or discrepancies between different drawings or between different specification sections.
- M. Should some portion of the work appearing on the HVAC Drawings and/or the Division 23 Specifications also be addressed in part or whole on the Drawings of another trade, or in the specifications of another Division, the cost of the work indicated on the HVAC / Division 23 documents shall be included with the Division 23 Contractor's bid price, unless explicitly clarified otherwise during the bidding period by the Architect / Engineer. During the construction period, prior to submitting the relevant materials and equipment for review, coordinate with the other affected trades and obtain clarification from the Architect / Engineer.
- N. Details shown on the Drawings shall apply to all instances of such item or condition indicated elsewhere on the Drawings, with or without an explicit reference thereto.
- O. The Drawings and Specifications primarily indicate the work that is required by the contract. In selected instances, an indication of work that is NOT acceptable may be made in the Contract Documents in order to provide additional emphasis or clarity. The omission of a similar statement elsewhere in the Documents shall not be construed by the Contractor to mean that unspecified or unindicated work will be accepted or is permitted under this contract.
- P. Where a code, standard, or other reference document is referenced, unless explicitly indicated otherwise, it shall be taken to refer to the most recent published version / edition at the time of bidding.
1. Exception: For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- Q. In cases where equipment and materials are specified in the singular or plural number, it is intended that such reference shall apply to as many such items as are required to complete the installation.

- R. In these Specifications, the words "shall," "shall be," "shall include," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
- S. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
- T. Compliance with requirements and performance of the work described in the Contract Documents are the responsibility of the Contractor unless specifically stated otherwise.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Mechanical Sleeve Seals:
    - a. Advance Products and Systems Inc.
    - b. Calpico, Inc.
    - c. Flexicraft Industries
    - d. Metraflex Co.
    - e. GPT, an EnPro Industries Company
    - f. Proco Products Inc.
    - g. Or equal as approved by the Professional.
  - 2. Fire- and Smoke-Stopping Materials and Assemblies:
    - a. Dow Corning Corp.
    - b. 3M Fire Protection Products
    - c. GE Silicones
    - d. Hilti, Inc.
    - e. HoldRite; a Div. of RWC
    - f. Specified Technologies Inc. (STI)
    - g. Legrand
    - h. Or equal as approved by the Professional.
  - 3. Fire-Stop Pipe Sleeves:
    - a. Hilti, Inc.
    - b. Holdrite
    - c. Pro-Set Systems Inc.
    - d. Or equal as approved by the Professional.

### 2.2 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.



## 2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32.
  - 1. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.
  - 2. Flux: ASTM B 813, non-self-cleaning type.
- C. Brazing Filler Metals: AWS A5.8.
  - 1. Use Type BCuP (copper-phosphorus) alloy meeting AWS 'BCuP-3' specification (e.g. Sil-Fos 5, or approved equal) for joining copper socket fittings with copper pipe.
  - 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel, with a compatible flux.

## 2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve. Concentric or eccentric types to suit field conditions.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each link.
  - 4. Pressure Rating: Designed for up to 20 psig differential, with a 4x safety factor.

## 2.5 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
  - 1. Steel Sheet Metal: 0.0336-inch minimum thickness (22 gauge), galvanized, round tube closed with welded longitudinal joint.
  - 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
  - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
  - 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
    - a. Underdeck Clamp: Clamping ring with set screws.
- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
  - 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
  - 2. OD: Completely cover opening.
  - 3. Cast Brass: One piece, with set screw. Polished chrome-plated finish.-
  - 4. Cast Brass: Split casting, with concealed hinge and set screw. Polished chrome-plated finish.
  - 5. Stamped Steel: One piece, with set screw and chrome-plated finish.
  - 6. Stamped Steel: One piece, with spring clips and chrome-plated finish.

7. Stamped Steel: Split plate, with concealed hinge, set screw, and chrome-plated finish.
8. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
9. Cast-Iron Floor Plate: One-piece casting.

## 2.6 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
  1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psig, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## 2.7 FIRE AND SMOKE -STOPPING MATERIALS

- A. General Requirements for Fire-and Smoke Stopping Materials: Provide --listed fire-stopping and smoke-stopping systems and assemblies for filling openings around duct, conduit, low-voltage cable, and piping penetrations of Division 23 work through walls, partitions, slabs, and floors as required by the International Building Code and any local amendments. Unless more restrictive requirements are referenced in Division 07, comply with the following:
- B. Fire Stopping Products:
  1. Systems and assemblies shall have fire-resistance ratings equal to or greater than adjacent construction and as established by testing identical assemblies per ASTM E 119 or ASTM E 814.
  2. The listing of the assembly / system proposed at each installation in one of the following shall be considered sufficient evidence of acceptable testing:
    - a. UL 1479 or UL 263 listed in Underwriters Laboratory, Inc. "Fire Resistance Directory".
    - b. Factory Mutual System "Approval Guide"
    - c. Warnock Hersey "Certification Listings"
    - d. A current evaluation report from the National Evaluation Service ("NES") will also be acceptable.
  3. Wall Penetrations: The F-Rating shall be not less than the fire-resistance rating of construction penetrated.
  4. Floor Penetrations:
    - a. F-Rating: Not less than the fire-resistance rating of construction penetrated.
    - b. T-rating: Not less than the F-rating, except for floor penetrations within the cavity of a wall. Supplemental insulation in accordance with tested and listed systems shall be provided on penetrating items where it is required to meet the required T-rating.
  5. It is the Contractor's responsibility to determine the types of penetrations to be sealed and to select appropriate listed fire-stopping assemblies.
  6. If a tested assembly is not available for a particular penetration configuration, modify the penetration configuration to suit available assemblies; do not modify assembly configuration except as specifically stated in the test report or as approved by the authority having jurisdiction.
  7. Products installed in air handling plenums shall be UL 2043 listed.

8. Provide products which:
  - a. Allow normal expansion and contraction movement of the penetrating item without failure of the penetration seal.
  - b. Emit no hazardous, combustible, or irritating by-products during installation or curing period.
  - c. Do not require special tools for installation.
- C. Smoke-stopping: Use any gunnable or pourable joint sealant suitable for the application; use only fully curing types where accessible in the finished work. Provide products which:
  1. Allow normal expansion and contraction movement of the penetrating item without failure of the penetration seal.
  2. Emit no hazardous, combustible, or irritating by-products during installation or curing period.
  3. Do not require special tools for installation.
- D. Fire-Stop Pipe Sleeves: At the option of the Contractor, and if approved by local codes, prefabricated fire-stop pipe sleeves also may be utilized. Pipe sleeves shall be UL 1479 or UL 263 Listed, and tested in accordance with ASTM E 814 or ASTM E 119. Sleeves shall be adjustable and shall be filled with ceramic fiber material to provide insulation and fire stopping. Sleeves shall provide a 2-hour fire rating.
- E. Labels: Red, permanent marking using the words "Fire-Rated Assembly - Do Not Disturb - See Maintenance Instructions" and the testing agency designation, or equivalent as approved by the authority having jurisdiction.
  1. For marking fire-stopping and smoke-stopping assemblies, use self-adhesive tape or wired-on labels.
  2. For marking fire and smoke barriers and partitions and slabs themselves, use letters at least 2 inches high.

## 2.8 MATERIALS USED IN AIR PLENUMS

- A. All materials provided under Division 23 that are installed within, or otherwise exposed to, an air plenum shall meet the requirements of the International Mechanical Code and shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested to UL 723 Test for Surface Burning Characteristics of Building Materials, or ASTM E84. Exceptions include:
  1. Wiring shall have a peak optical density not greater than 0.50, average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet, when tested in accordance with NFPA 262.
  2. Pneumatic tubing shall have a peak optical density not greater than 0.50, average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet, when tested in accordance with UL 1820.
  3. Electrical and control equipment with combustible enclosures, other discrete mechanical products, and firestopping shall be listed and labeled for plenum use in accordance with UL 2043.
  4. Non-metallic ducts and flexible ducts shall be Class 0 or Class 1 air ducts per UL 181.
  5. Pipe and duct insulation shall additionally not flame, glow, smolder, or smoke when tested in accordance with ASTM C4111.

- B. Where a specified material does not comply with the above, and is indicated to be installed in an air plenum, the material shall be concealed with 3M "Fire Barrier Plenum Wrap 5a+", Unifrax "FyreWrap 0.5 Plenum Insulation", or approved equal UL listed insulation that permits the wrapped item(s) to meet the requirements of the International Mechanical code for use in a plenum, per UL 723, UL 1887, NFPA 262, or ASTM E84 test procedures. Such insulation shall also be provided where indicated on the Drawings.
- C. Air plenums may include spaces such as above-ceiling and below-floor cavities, attics, crawlspaces, and mechanical equipment rooms and closets, where those spaces are used to convey supply, return, exhaust, ventilation, or relief airflow.

## 2.9 CEILING, WALL, CHASE, AND SHAFT ACCESS PANELS

- A. The Division 23 Contractor shall provide factory-fabricated access panels (i.e. doors) for access to concealed dampers, valves and other equipment provided under Division 23 where no other means of access is available. Panels are generally not shown on the Drawings for clarity purposes only. The Division 23 Contractor shall review the architectural documents for where inaccessible ceilings are located. Unless more restrictive requirements are referenced in Division 08, comply with the following:
  - 1. Access panels shall be of appropriate size but not less than 20x20 inches, flush type, concealed hinge, screwdriver-operated cam latch, stainless steel in tile work and white powder-coated sheet steel in drywall, plaster or CMU. Door and frame shall be minimum 16 gauge. Provide larger sizes where explicitly indicated on the Drawings or where required to adequately perform the access function. Exact locations and sizes of panels shall be determined by the Division 23 Contractor through the coordination drawing generation process, and panels shall be located for a symmetrical appearance. Locations for access panels in finished areas must be approved by the Architect / Engineer. Access panels are not required at lay-in tile ceilings.
  - 2. At locations where access panels are installed in fire-rated construction, access panels shall comply with NFPA 80 and be UL, Intertek, QAI, or Warnock Hersey listed and labeled for a fire rating required by the International Building Code based on the fire rating of adjacent construction, according to NFPA 252 or UL 10B. Doors shall be self-closing and self-latching, and shall incorporate fire-rated insulation. Doors on rated shaft construction and smoke barriers / partitions shall additionally have an S-label per UL 1784. Fire-rated door installations shall be field-inspected in accordance with NFPA 80.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Acudor Products, Inc.
  - 2. Activar / J. L. Industries
  - 3. Karp Associates, Inc.
  - 4. Milcor; a Div. of Duravent Group
  - 5. Nystrom, Inc.
  - 6. Or equal as approved by the Professional.

## 2.10 AC CONDENSATE DRAIN PIPING

- A. Interior Gravity-Fed AC Condensate Drain Piping: Drawn-temper copper tubing (ASTM B 88, Type L) with soldered drainage pattern wrought-copper fittings (ASME B16.22).

## 2.11 AC CONDENSATE OVERFLOW PROTECTION

- A. Suspended indoor equipment, rooftop equipment, and floor mounted equipment outside of mechanical rooms that generates AC condensate shall be provided with a water level switch complying with UL 508 to provide protection against drain pan overflow by sensing a high condensate level in the drain pan, in conformance with the 2018 International Mechanical Code. The sensor shall de-energize the compressors upon detection of a high water level.
  - 1. Unless indicated otherwise:
    - a. The switch shall be a Rectorseal Model 'SS3' mounted in the primary drain pan, or approved equal.
    - b. Drains sized at 3/4-inch NPT may also use a Rectorseal Model 'SS1' mounted in the primary drain line, except where equipment is installed in a return air plenum, the sensor shall be approved for use in plenums per UL 2043. The plenum rated switch shall be a Rectorseal Model 'SS2AP' or approved equal installed in the drain pan's auxiliary overflow connection or as otherwise detailed on the Drawings.

## PART 3 - EXECUTION

### 3.1 HVAC DEMOLITION

- A. Refer to Division 01 and Division 02 for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material. Existing work is not permitted to be abandoned in place unless explicitly indicated. Piping shall be tagged as "Abandoned in Place" with the date of abandonment at the points of disconnection as well as along its length at maximum 20-foot intervals, where accessible.
  - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material. Existing work is not permitted to be abandoned in place unless explicitly indicated on the Drawings. Ducts shall be tagged as "Abandoned in Place" with the date of abandonment at the points of disconnection as well as along its length at maximum 20-foot intervals, where accessible.
  - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Client Agency.
- C. If pipe, ductwork, insulation, wiring, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

- D. The disposal of all demolished materials shall be in accordance with all applicable laws, and all costs shall be borne by the Contractor.
- E. Recover refrigerant in demolished systems in accordance with all applicable laws.
- F. Salvage Value: The Contractor shall utilize the salvage value of all demolished materials as a means of reducing his/her bid price, except for items specifically noted otherwise and as otherwise indicated in Division 02.
- G. No demolition shall occur which leaves the building interior without weather protection. All demolition of exterior surfaces shall be followed immediately by protective construction, either permanent or temporary.
- H. Review the construction documents, to determine the affected areas of the existing structure. Remove systems in the affected areas not to be reused including equipment, piping, ductwork, controls, hangers, supports, etc.
- I. Schedule demolition work with the Client Agency.
- J. All existing piping shall be saw-cut, not broken, at point where piping connects to existing.
- K. Where the project requires demolition of existing piping, ductwork, mechanical equipment, and similar services, all such systems shall be terminated in an approved manner to allow affected systems to remain in operation. Provide temporary caps on piping and ductwork at all points of connection between new and existing until new/modified systems are completed in the renovation area. Duct caps shall not be removed until all dust and dirt generating construction activities are complete and the renovation area has been cleaned.
- L. The draining of existing piping systems, and subsequent filling, venting of air, and chemical treatment required to perform the demolition and/or new piping system connections to existing systems shall be provided under this contract.
- M. Repair ductwork and associated insulation and jacketing where control devices and other work installed on or in existing to remain ductwork was removed.
- N. The Contractor shall, at his own expense, repair, replace and maintain in service, any utilities, facilities or services (underground, over ground, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction. The method used by the Contractor in repairing, replacing or maintaining the services shall be approved by the Architect and the Client Agency.
- O. Where ductwork systems serve both areas under construction and areas not affected by the construction, all branch ducts in the construction area shall be capped, and fans shall be rebalanced for new air quantities.

### 3.2 CUTTING AND PATCHING

- A. The Division 23 Contractor shall include in his bid all cutting and patching work required for the installation of HVAC work performed under Division 23. Any damage incident to cutting or other causes in the performance of the contract work shall be made good by replacement or repairs in a manner satisfactory to the Architect/ Engineer.
- B. Where piping, ducts, or other equipment pass through fire or smoke rated construction, furnish and install sleeves and thoroughly seal openings around sleeves, pipes, ducts, etc. With fire and

smoke resistant materials. Materials shall be provided to maintain the fire rating of the adjacent construction in accordance with the requirements of NFPA and other applicable codes.

- C. No structural members shall be cut without prior approval of the Architect.
- D. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- E. Repair cut surfaces to match adjacent surfaces.

### 3.3 INSTALLATION OF WORK ON THE ROOF

#### A. General Requirements and Scope:

1. Cutting of the roof slab/deck and roofing membrane for Division 23 work shall be by the General Contractor.
2. Roof curbs, roof support rails, and similar flashed-in roof accessories shall be furnished and installed by the Division 23 Contractor for all Division 23 work, except that the General Contractor shall perform cutting of the roof slab/deck and roofing membrane, and shall install base flashing. The General Contractor shall install the roof accessories.
3. Where new curbs, roof rails, and other new Division 23 work is installed on the roof that diverts or blocks water drainage to the drainage points (e.g. roof drains, gutters, etc.) , the Division 23 Contractor shall provide crickets on the uphill side of the obstruction in accordance with the roofing system manufacturer's requirements and recommendations. The slope of the cricket surface shall be no less than the slope of the rest of the adjacent roofing.
4. All roofing work shall be performed by experienced roofing sub-contractors who are certified by the roofing system manufacturer to perform installation of the particular existing roofing system(s).
5. Quantity, length, spacing, an arrangement of rooftop equipment, piping, and ductwork support rails shall be as required to provide the required support intervals per referenced standards in other Division 23 Sections and wind restraint requirements. The quantity shown on the Drawings (if any) is diagrammatic only.

B. Metal Roof Decks: Equipment curbs and roof support rails bearing directly on corrugated metal roof decks shall be provided with steel or hardwood blocking matching the corrugations to provide a flat and continuously supported surface under the bearing surfaces of the curb or rail, and so that the weight of the supported item(s) doesn't produce a flattening force upon the deck.

C. Minimum Curb Heights: The Division 23 Contractor shall verify that the height of equipment and duct curbs, support rails, pipe portals/roof chases furnished shall be sufficient to satisfy the requirements of the roofing system manufacturer, accounting for the roof insulation thickness at the location of each installed item, recognizing the use of tapered insulation, where applicable. The required height may be greater than the minimum height specified in other Division 23 Sections.

D. Counter Flashing: The Division 23 Contractor shall provide counter flashing and counter flashing receivers for all flashed in roof accessories (i.e. roof curbs and rails). Base flashing shall be provided by the General Contractor. Counter flashing receivers shall be of watertight construction and shall comply with the requirements of the latest edition of the SMACNA Architectural Sheet Metal Manual.

- E. Curb Insulation: The sides of curbs shall be provided with minimum 2" thick fibrous glass duct lining type insulation complying with ASTM C 1071, Type I or II. Insulation shall be provided with the curb or field-applied by the installing Contractor.
- F. Fastener Sealing: Fasteners penetrating flashing, equipment housings, and similar construction requiring a weatherproof installation shall be provided with neoprene backed sealing-type washers. Fasteners shall be stainless steel or hot dipped galvanized, except as noted otherwise elsewhere.

### 3.4 FIRESTOPPING AND SMOKESTOPPING INSTALLATION

- A. During bidding, the Division 23 Contractor shall thoroughly review the architectural drawings to determine the location and hour rating of fire resistance rated construction (e.g. walls, shafts, floors, etc.), and shall include in his bid the costs of providing all fire and smoke stopping of Division 23 work required by the 2018 International Building Code and Mechanical Code.
- B. Comply with Division 07 provisions unless more restrictive or demanding requirements are indicated below.
- C. Pre-Installation Inspection: The Division 23 Contractor, with the assistance and technical support of a fire- and smoke-stopping product manufacturer, shall inspect all fire and smoke barriers (floors, walls, partitions, and slabs) for penetrations of Division 23 work, and shall mark or otherwise identify all penetrations indicating action required: 1) repair; 2) firestopping; and/or 3) smokestopping.
  - 1. Conduct inspection prior to covering up or enclosing walls or ceilings.
  - 2. Conduct inspection jointly with authorized representative of authority having jurisdiction.
  - 3. Submit a report detailing findings of inspection to the Architect/ Engineer.
- D. Modifications: If the configuration of a particular penetration does not conform to the configuration necessary for the required firestopping assembly, notify the installer of the penetration for modification of the configuration to suit the assembly; do not use the firestopping assembly in other configurations except as specifically stated in the test report or as approved by the authority having jurisdiction.
- E. Permanent Identification of Penetrations:
  - 1. Near fire and smoke barriers, mark each exposed penetration with label identifying it as a fire-stopped or smoke-stopped assembly.
  - 2. Mark each fire and smoke barrier above lay-in ceilings with words identifying it as a fire or smoke barrier at intervals required by authorities having jurisdiction, but not less than 20 feet.

### 3.5 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.



- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

### 3.6 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each control valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and other flanged pipeline appurtenances, and at final connection to each piece of equipment.

### 3.7 EQUIPMENT AND PRODUCT INSTALLATION - COMMON REQUIREMENTS

- A. Install manufactured equipment, products, and systems in full accordance with the manufacturer's requirements and recommendations. Note that the manufacturer's requirements and recommendations may be more restrictive or require work beyond that explicitly shown on the Contract Documents. If a manufacturer permits but does not explicitly require their product to be installed in a manner that is inconsistent or incompatible with the Contract Documents, the content of the Contract Documents shall take precedence.
- B. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- C. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- D. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- E. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- F. Install equipment giving right of way to piping installed at required slope.
- G. Supporting equipment from roof and floor decking in steel framed buildings is prohibited. All equipment shall be supported from building steel structural system.

### 3.8 PAINTING AND FINISHING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09. In the event of a direct conflict between the provisions of Division 09, and this Section, Division 09 shall take precedence.
- B. Do not paint piping specialties and similar items with factory-applied finish. Do not paint bronze or copper materials. Do not paint fastener threads (except on pipe hangers and threaded rods), nameplates, identification devices and labels, flexible connectors, vibration control devices, meters and gauges, listed and labeled (e.g. UL) equipment and materials, and any items for which the proper function and/or longevity will be compromised by the application of paint.
  - 1. Apply protection / masking to items that shall not receive paint prior to paint surface preparation and painting. Coordinate and schedule this work with the General Contractor who is performing finish painting. Any damage to Division 23 work due to a failure to mask items that should not have been painted shall be replaced and repaired at no additional cost to the Client Agency.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish. Marred finishes on items exposed to view in finished spaces shall be replaced with new items when the severity of the damage or quality of the finish repair is judged to be unacceptable by the Architect or Engineer.
- D. At locations where it is necessary to cut and patch existing construction to perform Division 23 work, painting at each location shall be performed by the Division 23 Contractor. New finishes shall match existing finishes. Comply with the provisions of Division 09.
- E. Comply with all applicable SSPC-PA standards published by the Society for Protective Coatings.
- F. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- G. Surface Preparation: Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants. Follow the referenced SSPC-SP standards published by the Society for Protective Coatings.
  - 1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
  - 2. Iron and Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer; comply with SSPC-SP2 at the minimum.
  - 3. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel", for touching up shop-primed surfaces.
  - 4. Galvanized-Metal Substrates: Remove dust, grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. Clean using methods recommended in writing by paint manufacturer; comply with SSPC-SP1 at the minimum.
  - 5. Aluminum Substrates: Remove loose surface oxidation. Clean using methods recommended in writing by paint manufacturer; comply with SSPC-SP1 at the minimum.

- H. Interior Painting Scope and Application: In addition to painting requirements indicated on the Drawings and elsewhere in Division 23, refer to the Architectural Drawings and Division 09 in finished spaces, paint interior exposed equipment that is not factory painted, ductwork, ductwork insulation, hangers and supports for piping, ductwork, and equipment, miscellaneous iron and steel work, and uninsulated piping.

### 3.9 CONCRETE EQUIPMENT BASES

- A. Indoor Concrete Housekeeping Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
  1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  2. Base slabs under housekeeping equipment pads shall be cleaned and scarified, then prepared with a bonding agent, before pouring the equipment base.
  3. Bases shall be 4" high, unless otherwise noted.
  4. Unless otherwise indicated, install #4 hooked dowel rods on 18-inch centers around the full perimeter of the base to connect the concrete base to the concrete floor. Dowels shall be epoxied into the floor slab. The top of dowel shall be 1-1/2" clear of top of pad, and shall be set 6" inward from the edge of the pad.
  5. Equipment pads shall be reinforced with 6x6x2.9x2.9 welded wire mesh fabric.
  6. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
    - a. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - b. Anchor bolts for equipment shall be placed when pad is being poured.
    - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
    - d. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  7. Use 4000-psi, 28-day compressive-strength concrete and reinforcement as specified in the "Concrete Work" Article herein.
  8. Edges shall be provided with a 3/4" chamfer.

### 3.10 CONCRETE WORK

- A. Scope: Provide concrete work related to new and repair work included under this Division. Construct concrete forms and equipment pads / bases for the new floor- or grade-mounted equipment installed under this Division. Pads and forms shall be of suitable dimensions for all equipment.
- B. Comply with the provisions of this Section, and the provisions of Division 03, whichever are more demanding. Concrete work shall be constructed subject to the approval of the Architect / Engineer.
- C. Concrete shall attain a minimum compressive strength of 4,000 psi at the age of 28 days, unless otherwise indicated on the Drawings. Tests shall be made by an approved laboratory if in the opinion of the Architect the concrete is not satisfactory. Costs in connection with tests of concrete shall be borne by the Contractor.

- D. Materials used for plain and reinforced concrete and the measuring, mixing, handling, placing and curing shall conform to current specifications of the American Concrete Institute (ACI 304 and ACI 318-71). Cement shall be normal Portland cement, Type I or Type II, conforming to ASTM Designation C-150.
  - E. Aggregates shall consist of sand of approved quality, crushed stone, and washed gravel conforming to ASTM Standard Specification Designation C33 and shall be supplied from a source approved by the Architect. The maximum size of the aggregate shall be no larger than 1/5 of the narrowest dimensions between forms of the members for which the concrete is to be used, no larger than 3/4 of the minimum clear spacing between reinforcing bars. Water for concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.
  - F. Slag in any form will not be permitted as an aggregate.
  - G. Proportions shall be in accordance with American Concrete Institute Standard "Recommended Practice for the Design of Concrete Mixes ACI 211.1."
  - H. Metal reinforcement shall be deformed steel bars, cold-drawn steel wire, or fabricated forms of these materials. Bars shall be deformed, intermediate grade new billet steel. These materials shall conform in quality to latest published standard specifications of the American Society for Testing Materials as follows:
    - 1. Bars:
      - a. Billet-Steel Bars for Concrete Reinforcement, ASTM A615.
      - b. Rail-Steel Bars for Concrete Reinforcement, ASTM A616.
    - 2. Wire: Cold Drawn Steel Wire for Concrete Reinforcement, ASTM A82.
    - 3. Fabricated Materials:
      - a. Steel Bar Mats for Concrete Reinforcement, ASTM A184.
      - b. Welded Wire Fabric for Concrete Reinforcement, ASTM A185.
  - I. Forms shall be of steel or wood and shall conform to the shape, lines, grades and dimensions of the concrete. Formwork shall comply with ACI 347. They shall be sufficiently tight to prevent leakage of mortar and shall be properly braced and tied together so as to maintain the desired position and shape during and after placing concrete. Forms shall be removed in such a manner as to assure the complete safety of the structure. Exposed corners or edges shall be chamfered. Burrs, fins, irregularities of forming, or spillage shall be removed and the surface float or trowel finished to a smooth straight surface.
  - J. Concrete shall be integrally waterproofed with Aquabar, or approved equal additive.
  - K. Water stops of plastic as manufactured by Ryerson, or approved equal, shall be installed in concrete joints and between pours.
  - L. An approved bonding agent shall be utilized where new concrete is to be placed on or against existing concrete.
- 3.11 ERECTION OF METAL SUPPORTS AND ANCHORAGE
- A. Refer to Division 05 for metal fabrications.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Furnish and install miscellaneous iron work including, but not limited to, piping hangers, piping anchors and guides, ductwork hangers and supports, and HVAC equipment supports. Additional structural members shall be furnished and installed to support the HVAC equipment without excessive stress or strain on the building construction. Structural beams and other structural members shall be furnished and installed under this Division for anchors and guides where the building steel is not available or of sufficient size or weight to support or anchor pipe lines and equipment.
- D. Equipment and materials furnished and installed under this Division which are not mounted on bases or floors shall be securely attached and supported from the main supporting structure of the building by metal hangers, clamps and/or brackets. Metal hangers, clamps and/or brackets shall be of suitable design and of sufficient strength to properly and safely support the materials and equipment involved.
- E. Field Welding: Comply with AWS D1.1.
  - 1. Welding shall be done by qualified welders certified as having fully complied with acceptable qualification tests as prescribed by a reputable testing agency using procedures approved by the American Welding Society.
- F. Structural steel members installed at the exterior of the building or in damp or wet locations shall be hot dipped galvanized after fabrication. Conform to ASTM A123. Where exterior structural steel members are cut, drilled or welded, or galvanizing is damaged, repair with a cold galvanizing repair compound with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20, as manufactured by ZRC Products Company, or equivalent.

### 3.12 GROUTING

- A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION 230500

## SECTION 230513

### COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes general requirements for electrically commutated motors, and for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on AC power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Additional related sections include:
  - 1. Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Variable Frequency Drive (VFD) Testing and Adjustment Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

##### 1.4 QUALITY CONTROL

- A. Comply with NFPA 70.
- B. Listing and Labeling: Provide motors specified in this Section that are listed and labeled.
  - 1. Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.
- C. Minimum Efficiency: Conform to requirements of NEMA MG 1, Table 12-12, as per the Federal Energy Independence and Security Act of 2007 (EISA), and DOE 10 CFR 431, as applicable, for minimum energy efficiency ratings of motors.
- D. Source Quality Control: Perform the following routine tests according to NEMA MG 1:
  - 1. Measurement of winding resistance.
  - 2. No-load readings of current and speed at rated voltage and frequency.
  - 3. Locked rotor current at rated frequency.
  - 4. High-potential test.
  - 5. Alignment.

## 1.5 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.
- B. The Division 23 Contractor shall be responsible for any additional costs to the Division 26 Contractor such as larger VFDs and wiring resulting from providing motors with high inrush current ratings such as "super premium" AC induction motors or those with design A starting characteristics.
- C. The Division 23 Contractor shall be responsible for any additional costs to the Division 26 Contractor such as larger VFDs and wiring resulting from any changes in motor sizes initiated by the Division 23 Contractor, from sizes scheduled on the Drawings due to a substitution from the Basis of Design equipment.
- D. Coordinate with the variable frequency drive suppliers to perform drive settings and adjustments appropriate for each drive and control application.

## 1.6 SPECIAL WARRANTY

- A. Manufacturer's Extended Warranty on Motors Used with Variable-Frequency Controllers: Written warranty, signed by manufacturer agreeing to repair or replace motor, including labor.
  - 1. Warranty Period: Manufacturer's standard, but not less than three (3) years after date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. 3-Phase Induction Motors:
    - a. Lincoln Motors; Div. of Regal Rexnord
    - b. Marathon Motors; Div. of Regal Rexnord
    - c. General Electric Co.
    - d. Toshiba
    - e. Baldor / Reliance Electric Co.; Div. of ABB Motors and Mechanical Inc.
    - f. US Motors; Div. of Nidec Motor Corp.
    - g. WEG Electric Corp.
    - h. Siemens
    - i. TECO-Westinghouse Motor Co.
    - j. Leroy-Somer; Div. of Emerson Industrial Automation
    - k. Or equal as approved by the Professional.

2. Permanent Magnet Electrically Commutated Motors (ECMs):
  - a. Baldor; a Div. of ABB Motors and Mechanical Inc.
  - b. EBM-Papst
  - c. Nidec Motor Corp.
  - d. Regal Rexnord
  - e. Zeihl-ABEGG
  - f. Or equal as approved by the Professional.

## 2.2 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: Determined by voltage of circuit to which motor is connected.
- E. Service Factor: According to NEMA MG 1, unless otherwise indicated.
- F. Enclosures: Open drip-proof (ODP), unless otherwise indicated. Use totally enclosed fan-cooled (TEFC) motors where installed at the exterior of the building or where installed in damp or wet locations.
- G. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- H. Overload Protection:
  1. All motors shall be provided with thermal overload protection at the manual or magnetic motor starter or variable frequency controller, as per NFPA 70.
  2. All single phase motors, and all three phase motors used with variable frequency controllers shall have integral thermal protective devices.

## 2.3 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

## 2.4 POLYPHASE AC INDUCTION MOTORS

- A. Description: NEMA MG 1, medium induction motor.
  1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
  2. Minimum Energy-Efficient Design: Conform to EISA requirements.



3. Stator: Copper windings, unless otherwise indicated. Multispeed motors shall have separate winding for each speed.
  4. Rotor: Random-wound, squirrel cage.
  5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
  6. Temperature Rise: Match insulation rating, unless otherwise indicated.
  7. Insulation: Class F, unless otherwise specified.
  8. All squirrel cage, three phase, induction motors 15 HP and larger shall have a maximum locked rotor starting KVA/HP no greater than that specified for NEMA Code "G" (5.6 to 6.3).
  9. Enclosure Material: Unless indicated otherwise in other Division 23 Sections, cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
  10. Full Load Current Ratings: Shall not exceed NEC Table 430.250 - "Full Load Current, Three-Phase Alternating-Current Motors". If 6 and 8 pole motors with full load currents exceeding the values of this table are provided, the Division 23 Contractor shall be responsible for any additional costs to the Division 26 Contractor such as larger VFDs and input wiring.
- B. Motors Used with Variable-Frequency Drives / Controllers (VFDs / VFCs) or Indicated on the Drawings or Elsewhere in the Specifications as "Inverter Duty": Ratings, characteristics, and features coordinated with and approved by controller manufacturer. Comply with the above article "Polyphase Motors" but with the following additional requirements:
1. Design Characteristics: NEMA MG 1, Part 31 "Definite-Purpose Inverter-Fed Polyphase Motors."
  2. Temperature Rise: Match rating for Class F insulation.
  3. Insulation: Class H.
  4. No limitation on cable run between motor and variable-frequency controller.
  5. Thermal Protection: Conform to NEMA MG 1 requirements for thermally protected motors.
  6. Bearing Protection: Motors 3 HP and larger shall be provided with ring type shaft grounding brushes (EST 'Aegis SGR' or approved equal). The rings may be motor factory mounted or field installed (split-type rings are acceptable). The rings shall be installed on either the drive end or the non-drive end of the motor in accordance with manufacturer's installation instructions. Clean the shaft and coat the contact surface on the shaft with the grounding ring manufacturer's recommended conductive paste (colloidal silver) before installing the ring.
  7. Turndown Ratio: No less than 10:1 when powered through a variable frequency drive with scalar (V/Hz) -type control, and no less than 20:1 with a drive with vector-type control.
  8. Frequency (Speed) Ratings: The motor shall be factory warranted by motor manufacturer to operate at frequencies between 6Hz and 90 Hz. Higher frequency ratings shall be provided where required by the equipment manufacturer to achieve the required performance, however the speed limitations of Table 30-1 of NEMA MG-1 shall not be exceeded unless explicitly scheduled otherwise.

## 2.5 SINGLE-PHASE MOTORS

- A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application. Note that none of the motor types listed immediately below may be provided in substitution for a permanent magnet, electrically commutated motor (ECM).
1. Permanent-split capacitor.
  2. Split-phase start, capacitor run.
  3. Capacitor start, capacitor run.

4. Electrically commutated.
- B. Shaded-Pole Motors: Do not use.
  - C. Thermal Protection: Internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range.
  - D. Bearings: Ball-bearing type for all EC type motors, belt-connected motors, and other motors with high radial forces on motor shaft. Sealed, permanently prelubricated sleeve bearings are acceptable for other, single-phase motors.

## 2.6 ELECTRICALLY COMMUTATED MOTORS (ECMs)

- A. Synchronous, constant torque, brushless DC type, specifically designed for HVAC applications, with a permanent magnet rotor and integral solid state inverter circuitry to accept single or 3-phase AC power input and to control the power output and speed of rotation.
  1. Integral controllability down to 20% of full, rated speed. No external speed controller shall be required.
    - a. Speed shall be adjustable by integral potentiometer dial (for balancing purposes) and/or by external 0-10 VDC control signal, as required by the application and control sequence of operation. Motors serving fans and pumps indicated in the sequence of operation to have on-off and/or speed control shall receive an external binary and/or analog signal for this purpose. Note that for many EC motors, an analog speed control signal below a certain value is used to automatically de-energize the motor. Coordinate signal type requirements between the equipment supplier and the control system sub-contractor / supplier performing the work of Division 23 Section "Instrumentation and Control for HVAC". For bidding purposes, provide EC motors with both a manual dial and the ability to receive an analog speed signal.
  2. Minimum 85% efficiency over full speed range.
  3. Permanently lubricated ball bearings which are not dependent on motor speed for lubrication.
  4. Integrated power factor correction filter.
  5. Integrated motor protection verified by UL to protect the pump against over-/undervoltage, overtemperature of motor and/or electronics, overcurrent, locked rotor, and dry run (no-load condition).
- B. Provide ECMs where explicitly indicated, either in other Division 23 Sections, or on the Drawings.

## PART 3 - EXECUTION

### 3.1 VARIABLE FREQUENCY DRIVE TESTS AND SETTING ADJUSTMENTS

- A. The Division 23 Contractor is responsible for the work of this Article for each variable frequency drive (VFD) provided under this Project controlling Division 23 equipment regardless of which Division provided each VFD.

- B. Adjustments shall be made in accordance with the VFD manufacturer's recommendations and requirements. Where required, the VFD manufacturer's authorized representative shall be present for drive commissioning and set-up procedures/adjustments. For factory equipment mounted VFDs, the equipment manufacturer's representative shall be present. The Division 23 Contractor shall include in his bid the costs of obtaining the services of these representatives. The Division 23 Contractor shall assume that dedicated trips to the project site will be necessary to perform all necessary adjustments. No additional payment will be made by the Client Agency for these services.
- C. All required VFD parameter setting adjustments shall be made to ensure the proper and safe operation of the driven equipment, including start up, shut-down, and emergency operational modes, including VFD bypass / hand modes, as applicable. The required tests and adjustments include, but are not limited to, the following:
1. Coordinate with the automatic temperature controls supplier / sub-contractor to make all necessary operational and control parameter adjustments, including lock-out of any resonant speeds.
  2. VFD Communications: Verify that the VFD is communicating with the building automation system, including read and write parameter settings.
  3. Testing and Balancing: Perform the following adjustments in cooperation with the Testing and Balancing Agent.
    - a. For direct-drive fans equipped with variable frequency drives, determine the output frequency of the drive required to achieve the scheduled (design) fan performance.
      - 1) Note that that the required output frequency is very often above 60 Hz.
      - 2) Record the required output frequency at the design fan performance and measure voltage and amps of the motor for each phase.
      - 3) Additionally, determine and record the maximum output frequency that results in operation of the motor at 95% of the motor nameplate ampacity or operation of the fan just above breakdown torque of the motor, whichever is reached first.
      - 4) Report the recorded test results to the Engineer.
      - 5) Re-set the VFDs maximum output speed to the value recommended by the Architect / Engineer.
      - 6) Verify that the final settings corresponds to, or is lower than, the maximum RPM for the fan wheel class, and will prevent motor overload in normal operation.
  4. Test for smooth and stable operation of the equipment at speeds varying from minimum to maximum.
  5. VFD carrier frequency settings shall be field adjusted to the lowest value that does not create objectionable noise in occupied spaces in order to minimize motor temperatures. Settings lower than 6 kHz are desirable.
  6. In cooperation with the Division 26 Contractor, set field-adjustable switches and circuit-breaker trip ranges.
  7. Jog each motor and verify proper motor rotation.
  8. For individual VFDs serving more than one motor load, verify that the VFD is operating in a compatible mode as recommended by the VFD manufacturer (e.g. 'voltage-frequency' mode).
  9. Conduct tests to verify that the following VFD features are working correctly:
    - a. Automatic Reset/Restart: The VFD attempts six (6) restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction.

- b. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
  - c. Flying Start: Enable and test the bidirectional auto-speed search feature that permits starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
  - d. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
10. Verify that selector switches with control circuit in both hand and automatic positions have been connected to all safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.
11. Verify that 'run permit' interlock wiring between early break, late make auxiliary contacts on the load-side disconnect switch and remote VFD has been provided. If such interlock wiring is not indicated on the electrical documents, then provide signage at the local disconnect switches and the associated VFD(s) that reads "De-energize equipment at the VFD prior to interrupting power to the equipment at the disconnect switch."

END OF SECTION 230513

## SECTION 230529

### HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 ADDITIONAL RELATED DOCUMENTS

- A. Related Division 23 Sections include the following:
  - 1. "Common Work Results for HVAC" for metal fabrications for pipe and equipment supports.
  - 2. Division 23 Section "Vibration Controls for HVAC" for equipment and piping systems requiring vibration isolation hangers and supports.
  - 3. "Ductwork" for duct hangers and supports.

##### 1.3 SUMMARY

- A. This Section includes hangers and supports for HVAC system piping and equipment, and delegated design and engineering.

##### 1.4 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in ANSI / MSS SP-58.

##### 1.5 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents, and test water.

##### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

- B. Delegated Design Calculations and Shop Drawings: The Division 23 Contractor shall provide fabrication and installation drawings and include load and stress analyses calculations, signed and sealed by a professional engineer registered in Pennsylvania for the following:
  - 1. Pipe hangers and supports for piping.
  - 2. Channel and trapeze type supports.
  - 3. Equipment supports.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Welding Certificates: Copies of certificates for welding procedures and operators.

#### 1.8 QUALITY CONTROL

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with PFI (Pipe Fabrication Institute) Standard ES-26 "Welded Load Bearing Attachments to Pressure Retaining Piping Materials" for minimum recommended requirements for materials, design, fabrication and inspection of load bearing attachments, such as, but not limited to, ears, shoes, lugs, fins, rings, skirts, anchors, guides, etc., which are to be fabricated and welded to piping materials that will become part of a pressure retaining piping system.
- C. Delegated Design and Engineering Responsibility: The Division 23 Contractor is responsible for the delegated design and engineering provisions of this Section. Provide for the design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze, and equipment support, by a qualified professional engineer.
  - 1. Delegated Design Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in Pennsylvania and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.
  - 2. The design, layout and selection of piping hangers and supports shall comply with this specification section shall conform to the allowable pipe stress limits defined by ASME B31.9 - Building Services Piping.
    - a. After proposed piping layouts have been established and coordinated with the other disciplines by way of the coordination drawing generation process, and have been submitted to the design Architect / Engineer an information submittal, a set of the coordination drawings shall be forwarded to the delegated design Engineer who shall in turn complete his engineering stress analysis, and shall select and design the pipe hangers and supports. Detailed shop drawings of piping hangers and supports, shall then be prepared. These shop drawings shall be stamped by the delegated design Engineer with his/her registration seal prior to submission to the design Professional.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pipe Hangers, Saddles, and Shields:
    - a. Anvil International, Inc.
    - b. Carpenter & Paterson, Inc.
    - c. Modern Pipe Hanger Co., Inc.
    - d. National Pipe Hanger Corp.
    - e. Penn Pipe Hanger Corp.
    - f. ERICO International Corporation.
    - g. Eaton
    - h. Walraven
    - i. Or equal as approved by the Professional.
  2. Channel Support Systems:
    - a. Anvil International, Inc.; Power-Strut Unit.
    - b. Carpenter & Paterson, Inc.
    - c. National Pipe Hanger Corp.
    - d. Thomas & Betts Corp.
    - e. Unistrut Corp.
    - f. ERICO International Corporation.
    - g. Walraven
    - h. Or equal as approved by the Professional.
  3. Thermal-Hanger Shields and Shield Inserts:
    - a. Buckaroos Inc.
    - b. Carpenter & Paterson, Inc.
    - c. Extol of Ohio, Inc.
    - d. National Pipe Hanger Corp.
    - e. Pipe Shields, Inc.
    - f. Thermal Pipe Shields, Inc.
    - g. Value Engineered Products, Inc.
    - h. ERICO International Corporation
    - i. Or equal as approved by the Professional.
  4. Drilled-In Mechanical Fastener Systems for Concrete:
    - a. Gunnebo Fastening Corp.
    - b. Hilti, Inc.
    - c. ITW Ramset/Red Head
    - d. Or equal as approved by the Professional.
  5. Non-Penetrating Rooftop Support Systems:
    - a. PHP Systems / Design
    - b. Caddy Pyramid; a Div. of Pentair

- c. Big Foot Systems
- d. Miro Industries, Inc.
- e. Or equal as approved by the Professional.

## 2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: ANSI / MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
  - 1. Galvanized, Metallic Coatings: For all piping hangers, supports, supplemental steel, hardware and accessories. All piping hangers, supports, hardware and accessories located outside shall be stainless steel or hot-dipped galvanized, no exceptions.
  - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
  - 1. Coatings: Manufacturer's standard finish. All channel support systems and accessories exposed to weather shall be stainless steel or hot-dipped galvanized, no exceptions.
  - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Pipe Covering Protection Saddles: MSS Type 39, fabricated from carbon steel plate with edges rolled and ground smooth. Minimum length shall be 12". Depth of saddle shall be no less than the adjoining piping insulation thickness.
- D. Thermal-Hanger Shields and Shield Inserts: High compressive-strength insulation, with an MSS Type 40 G90 galvanized sheet metal shield. Shield shall have rounded corners.
  - 1. Insulation Material for Cold Piping: ASTM C 552, Type I cellular glass, or ASTM C 1126, Type III rigid phenolic foam with a minimum 3.75 PCF density. Insulation shall have a low perm (0.02 perm or less) all service jacket.
  - 2. Insulation Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
  - 3. Plenum Rating: Insulation shall have a flame spread index of less than 25, and a smoke developed index less than 50, when tested in accordance with ASTM E84-15a.
  - 4. Insulation Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.
  - 5. Insulation Thickness: Same thickness as adjoining piping insulation. Insulation shall span 360 degrees.
  - 6. Shield for Trapeze or Clamped System: Shield shall cover entire circumference of pipe (360 degrees).
  - 7. Shield for Clevis Hanger: Shield shall cover no less than the lower 180 degrees of pipe.
  - 8. Minimum Shield Lengths and Gauge:
    - a. Piping Sizes up to 3": 6" long and 20 gauge.
    - b. Additional thickness and length shall be provided as required to prevent more than 5% compression of insulation with the piping system filled.



## 2.3 MISCELLANEOUS MATERIALS

- A. Drill-In Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners shall be galvanized steel, except use stainless steel where supporting stainless steel hangers and supports. Anchors shall be of the expansion-wedge or screw-in type.
- B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, galvanized. All structural steel members, plates, shapes, and bars exposed to weather shall be hot-dipped galvanized, no exceptions.
- C. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
  - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  - 2. Properties: Non-staining, noncorrosive, and nongaseous.
  - 3. Design Mix: 5000-psi, 28-day compressive strength.

## 2.4 NON-PENETRATING ROOFTOP SUPPORT SYSTEMS

- A. This Article applies to both piping and equipment.
- B. All piping and equipment located on the roof shall be supported by factory fabricated and engineered support system using with structural steel members bearing on support bases that do not penetrate the roofing system. Provide bracing members, bolts, nuts, washers and other accessories required to provide a complete system. All structural members and fasteners shall be stainless steel or hot dipped galvanized in accordance with ASTM A 153 or A 123.
  - 1. Where exterior structural steel members are cut, drilled or welded, or galvanizing is damaged, repair with a cold galvanizing repair compound with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20, as manufactured by ZRC Products Company, or equivalent.
- C. All piping and equipment supports shall set the bottom of the pipe or equipment no less than 18" above the finished roof surface. Additional clearance shall be provided, depending on the width of the supported items. Roof clearances shall comply with Figure 6-4 of SMACNA Publication "HVAC Duct Construction Standards--Metal and Flexible, 3rd Edition, 2005."
  - 1. The piping supports shall be dimensioned to account for field applied insulation.
  - 2. Pipe support spacing shall comply with the applicable ASNI / MSS-SP-58 and these specifications. The quantity shown on the Drawings (if any) is diagrammatic only.
  - 3. Equipment supports shall be arranged to comply with the supporting requirements of the equipment manufacturer.
- D. Acceptable Products: Subject to compliance with the requirements, provide products by one of the following:
  - 1. Erico 'Caddy Pyramid' Support Systems:
    - a. 'ST' series bases for piping 1.5" and smaller, in groups of 4 pipes or less.
    - b. 'H-Frame' type support bases for equipment.

2. PHP Systems.
  3. Big Foot Systems - "Multi-Foot", "H-Frame", "LD Frame" and "HD Systems"
  4. Miro Industries:
    - a. "Mechanical Unit Support - HD" Series for equipment.
    - b. "H" Series Systems for piping.
    - c. Or equal as approved by the Professional.
- E. Piping shall be supported with clevis hangers, roller supports, etc. complying with the specification requirements listed elsewhere in this Section. Those hangers and supports shall be secured to channel or threaded rod supports attached to one of the above listed support base systems.
- F. Prefabricated system shall be specifically designed for outdoor use and installation without roof penetrations, flashing or damage to roof materials (insulation, membrane, etc.). Support bases shall be molded high density/high impact polypropylene with UV inhibitors and anti-oxidants.
1. Prior to installation, verify compatibility with the existing roof membrane.
  2. Provide roof pads. Consult manufacturer of the roofing system as to the type of isolation pads required between the roof and base.
  3. The system shall not void the existing roof bond.
- G. The entire piping and equipment support system shall be factory engineered and designed for each project, for the specific weight and dimensions of the item being supported.
1. The maximum allowable loadings per support base shall be based on the exact type of roof insulation present, using a safety factor of 2.0 against published minimum ultimate values of insulation compression strength (NRCA Commercial Low-Slope Roofing Materials Guide, 1994 Edition). The manufacturer must also ensure adequacy against punching resistance and overall structural integrity of the roof on which the assembly is placed.
- H. When requested by the Professional, provide a factory-trained representative of the manufacturer to visit the site while the work is in progress to assure that the installation conforms to the support system manufacturer's design and installation requirements.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Refer to Division 23 Section "Vibration Controls for HVAC" for equipment and piping systems requiring vibration isolation hangers and supports. Vibration isolated piping and equipment shall be installed such that they do not contact building structure, walls, or other building elements or work that fixed in place.
- C. Comply with ANSI / MSS SP-58 and 127 for pipe hanger selections and applications that are not specified in piping system Specification Sections. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- D. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

- E. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- F. Use thermal-hanger shield inserts for insulated piping and tubing.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
  - 1. Modern Pipe Supports Corp. Figure 404, Government ring pipe clamp with Figure 540 turn buckle adjuster and threaded rod hanger.
  - 2. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if no insulation is specified / required.
  - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
  - 6. Clips (MSS Type 26): For support of insulated pipes on channel type and trapeze supports that are not subject to expansion or contraction.
  - 7. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  - 8. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  - 9. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
  - 10. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  - 11. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  - 12. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
  - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  - 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  - 4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head room is limited.
- K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install factory fabricated saddles and shields of the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): Use only on hot steel piping without vapor barrier. Weld saddle to the steel pipe. Fill interior of saddle with the specified piping insulation.
  2. Protection Shields (MSS Type 40): Use on cold piping with vapor barrier, and all copper tubing. Length and metal thickness shall be as recommended by manufacturer to prevent crushing/compressing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, -insert of high-density, 100-psi minimum compressive-strength-- pipe insulation, same thickness as adjoining insulation with vapor barrier, with -a sheet metal shield.
- L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  3. Spring Hangers for Piping 3" and Smaller:
    - a. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

- b. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
- M. Comply with ANSI / MSS SP-58 and 127 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

### 3.2 HANGER AND SUPPORT INSTALLATION - GENERAL REQUIREMENTS

- A. Hanging piping and equipment from roof and floor decking in steel framed buildings is prohibited. All equipment shall be hung from building steel structural system (e.g. steel beams and joists).
  - 1. Piping and equipment shall be supported directly from the building's steel beams or from miscellaneous structural steel provided by the Division 23 Contractor bearing on steel beams.
  - 2. Joist Connections: Loads supported by steel bar joists exceeding 100 lbs. shall be located at the joist panel points, and shall not impose an eccentric load (twisting moment). Provide supplemental steel and align direct hanger connections to the joists with the joist centerline. Connect to both of the upper chord angles of the joist wherever it is possible to do so. Whenever it is not possible for loads exceeding 100 lbs. to be located a joist panel point, provide a strut to transfer the load to a panel point on the opposite chord. All joist reinforcement / modifications shall meet with the approval of the joist manufacturer and shall follow the recommendation of the Steel Joist Institute.
  - 3. Do not drill or cut building structural steel.
  - 4. Do not weld to building structural steel without explicit pre-approval from the Professional. Repair fireproofing after welding.
- B. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements related to installation of work on the roof.
- C. Pipe Hanger Installation: Comply with ANSI / MSS SP-58 and 127-. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- D. Trapeze Pipe Hanger (MSS Type 59) Installation: Comply with MSS SP-58 and 127-. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
  - 3. Threaded rods shall be minimum 3/8" size.
- E. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

- G. Fastener System Installation in Concrete Slab Construction:
1. Install drilled-in mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
  2. Anchor capacity used in design shall be based on the technical data published by the manufacturer or such other method as approved by the Professional.
  3. Anchor capacity is dependent upon spacing between adjacent anchors and proximity of anchors to edge of concrete. Install anchors in accordance with the manufacturer's recommended spacing and edge clearances.
  4. Reinforcing bars in the concrete structure may conflict with specific anchor locations. Exercise care to avoid damaging existing reinforcing or embedded items. The Contractor shall review the structural drawings and shall undertake to locate the position of the reinforcing bars near the locations of the concrete anchors, by Hilti 'Ferroscan, GPR', X-rays, or other non-invasive means approved by the Professional. Notify the Professional if reinforcing steel or other embedded items are encountered during drilling.
  5. Install concrete inserts before placing concrete.
- H. Roof-Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof support rail.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- P. Piping connecting to equipment shall be supported in such a manner that no pipe load is exerted on the equipment.
- Q. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield or shield insert with clamp sized to match OD of insert.

2. Install MSS SP-58, Type 39 pipe covering protection saddles, only on hot steel piping without vapor barrier.
  - a. Thermal-hanger shield inserts shall be used.
3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier and on copper tubing. Shields shall span arc of at least 180 degrees with clevis hangers and roller supports, and 360 degrees with clamps.
  - a. Thermal-hanger shield inserts shall be used.

### 3.3 PIPING RISER SUPPORTS

- A. Support locations shall be selected to permit uniform loading, provision for expansion or to suit space limitations. The riser clamps at exposed locations shall be of such design as to avoid creating a hazardous or unsightly condition and staying within space limitations.
- B. Risers of vertical piping shall be supported at each floor penetration by riser clamps.

### 3.4 EQUIPMENT SUPPORTS

- A. Rooftop equipment that is not installed on a perimeter roof curb shall be supported on non-penetrating rooftop ductwork support systems, unless indicated otherwise.
- B. Fabricate structural-steel stands to suspend equipment from structure overhead.
- C. Fabricate structural steel stands to support equipment above floor where required or indicated on the Drawings. Where an equipment stand is not indicated or required, set equipment on concrete housekeeping pads no less than 4" high.
- D. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- E. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.5 ROOF PIPING SUPPORT INSTALLATION

- A. Install roof curbs, pipe chases/ portals, and support rails in such manner as maintain roof bond. Provide roof opening, flashing, counter-flashing, sealant, roof insulation and structural framing members. Secure roof-mounted equipment to support rails with stainless steel hardware.
- B. Rooftop piping shall be supported on non-penetrating rooftop ductwork support systems, unless indicated otherwise.
- C. Piping penetrations of the roof shall be made with insulated metal roof curbs.

### 3.6 METAL FABRICATIONS

- A. Furnish and install miscellaneous iron work including, but not limited to, piping hangers, piping anchors and guides, and HVAC equipment supports. Additional structural members shall be furnished and installed to support the HVAC equipment without excessive stress or strain on the

building construction. Structural beams and other structural members shall be furnished and installed under this Contract for anchors and guides where the building steel is not available or of sufficient size or weight to support or anchor pipe lines and equipment.

- B. Equipment and materials furnished and installed under this Contract which are not mounted on bases or floors shall be securely attached and supported from the main supporting structure of the building by metal hangers, clamps and/or brackets. Metal hangers, clamps and/or brackets shall be of suitable design and of sufficient strength to properly and safely support the materials and equipment involved.
- C. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
  - 1. Where exterior structural steel members are cut, drilled or welded, or galvanizing is damaged, repair with a cold galvanizing repair compound with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20, as manufactured by ZRC Products Company, or equivalent.
- D. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- E. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  - 1. Welding shall be done by qualified welders certified as having fully complied with acceptable qualification tests as prescribed by a reputable testing agency using procedures approved by the American Welding Society.
  - 2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 3. Obtain fusion without undercut or overlap.
  - 4. Remove welding flux immediately.
  - 5. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### 3.7 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated or required slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches once the coordinated installations are complete. Any rod ends within 6'-8" of the finished floor shall be provided with rubber or vinyl screw thread caps and the piping or hanger marked with low clearance warning labels.

### 3.8 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.



- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

## SECTION 230548

### VIBRATION CONTROLS FOR HVAC

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 ADDITIONAL RELATED DOCUMENTS

- A. Related Division 23 Sections include the following:
  - 1. "Hangers and Supports for HVAC Piping and Equipment" for pipe hanger restraints.
  - 2. "Ductwork" for hanger materials for ductwork.
  - 3. "Air Duct Accessories" for flexible duct connectors.

##### 1.3 SUMMARY

- A. This Section includes vibration isolators, thrust restraints, and vibration isolation bases.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: Indicate types, styles, materials, and finishes for each type of isolator specified. Include load - deflection curves.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

##### 1.6 COORDINATION

- A. Coordinate layout and installation of vibration isolation devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate size and location of concrete housekeeping and vibration isolation bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03 Sections.
- C. Coordinate installation of equipment supports.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Vibration Isolation Products:
    - a. BRD Noise and Vibration Control Inc.
    - b. Kinetics Noise Control Inc.
    - c. Mason Industries, Inc.
    - d. Novia Associates Inc.; a Div. of Carpenter and Paterson
    - e. The VMC Group
    - f. Vibration Eliminator Co., Inc.
    - g. Vibro-Acoustics; a Div. of the Swegon Group
    - h. Or equal as approved by the Professional.

### 2.2 VIBRATION ISOLATORS

- A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.
1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip ribbed or waffle pattern and with steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
  2. Load Range: From 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.
- B. Spring Isolators: Freestanding, laterally stable, open-spring-type isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 0.75 times the rated vertical stiffness. The spring diameter shall be no less than 0.8 of the compressed height of the spring at rated load.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Baseplates: Factory drilled for bolting to structure and bonded to a 1/4-inch-thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to 500 psig.
  6. Top Plates: Provide threaded studs for fastening and leveling equipment.
  7. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.
- C. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.
1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch-thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 0.75 times the rated vertical stiffness. The spring diameter shall be no less than 0.8 of the compressed height of the spring at rated load.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.
- D. Spring Hangers: Combination spring and elastomeric hanger with coil spring and elastomeric insert in compression.
1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  6. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
  7. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.
  8. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.
- E. Thrust Limits (Restraints): Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

## 2.3 INDOOR VIBRATION ISOLATION EQUIPMENT BASES

- A. Fabricated Steel Bases: Structural-steel bases and rails designed and fabricated by the isolation equipment manufacturer. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.
1. Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A 36. Include support brackets to anchor base to isolation units. Include pre-located equipment anchor bolts and auxiliary motor slide bases or rails.

2. Design and fabricate bases to result in the lowest possible mounting height with not less than 1-inch clearance above the floor.
3. Weld steel angles on frame for outrigger isolation mountings, and provide for anchor bolts and equipment support.
4. Factory Finish: Manufacturer's standard corrosive-resistant finish.

## 2.4 LIGHT DUTY RESTRAINED ISOLATION SPRING RAILS

- A. Construction: The isolation system shall consist of two (2) independent isolation spring rails. Each spring rail shall consist of vibration isolation set beneath steel rails. The support rails shall be galvanized steel channels with a minimum of two (2) all-directional restraints per rail and factory located adjustable springs as required for dead loads.
- B. Wind Resistance: Spring rails shall be laterally stable, and shall be constructed to resist the wind forces exerted on the rails by the supported equipment in an IBC-specified design wind as per the project conditions described in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment".
- C. Isolation: Static deflection shall be minimum 1", or as indicated on the Drawings, whichever is greater. Vibration isolators shall be free standing, laterally stable springs wound from high strength spring steel set in a zinc plated steel housing. Springs shall have a lateral stiffness greater than 1.1 times the rated vertical stiffness under rated load and deflection. Springs shall be designed to retain a minimum of 0.75 inch travel beyond the rated capacity to accommodate overloads. Housing assembly shall be a steel member that includes provisions for attachment to the support rail or pad. It shall interface with a coil spring leveling assembly and a 3-axis restraint snubbing element that shall bolt directly to the underside of the equipment support rail. The housing shall be fitted with integral non-skid isolation pads and holes for anchoring the housing to the supporting structure. Springs shall be selected to provide operating static deflections as required. Springs shall be color coded or otherwise identified to indicate load capacity. Springs shall be factory powder-coated.
- D. Basis of Design: Kinetics Noise Control, Inc. - "LDR".
  1. Subject to compliance with requirements, the Contractor may provide equal products by the manufacturers listed in Article 2.1 of this Section.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS AND INSTALLATION

- A. General: Except as otherwise indicated\*, select vibration control products in accordance with ASHRAE Handbook, 2015 Edition of HVAC Applications Volume, Chapter 48 "Noise and Vibration Control", including Table 47. Where more than one type of product is recommended in Table 47, the selection is the Contractor's option so long as that type of product is specified in this Section.
1. Exceptions:
    - a. Type 3 (spring) hangers and mounts shall be used where Type 2 (rubber) hangers and mounts are indicated in Table 47.
    - b. Steel frame bases may be provided in lieu of concrete inertia bases for base mounted fans where the fan is controlled by a variable frequency drive and thrust restraints are provided in the direction of both the fan discharge and suction.
    - c. \*Specific indications on the Drawings or in an equipment specification Section elsewhere in Division 23 shall take precedence over the above referenced chapter of the ASHRAE HVAC Applications Handbook.
- B. All rotating, vibrating, and motor driven equipment shall be provided with field applied vibration isolation from one of the manufacturers listed elsewhere in this Section, except the following:
1. Where internal isolation has been provided as part of the factory-manufactured equipment package. The isolator products used shall comply with this Section, and other specific indications in the Contract Documents, including type and minimum amount of static deflection.
- C. Vertical Restraints: Vibration isolators shall be of the restrained type incorporating a vertical limit stop when applied to exterior equipment.
- D. Light Duty Restrained Isolation Spring Rails: Provide for rooftop condensing units and heat pumps.
1. If the weight of the supplied equipment exceeds the limits recommended by the manufacturer for light duty spring rails, provide heavy duty spring rails, Kinetics "QuietRail", or approved equal.
- E. Install and anchor vibration-control products according to manufacturer's written instructions and authorities having jurisdiction.
- F. Anchor interior mounts, isolators, and hangers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.
- G. Anchor exterior mounts, isolators, and hangers to vibration isolation bases. Bolt isolator baseplates to roof supports or structural supports as required by authorities having jurisdiction and the wind restrain design.
- H. Installation of vibration isolators shall not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.
- I. Equipment isolators and bases shall be dedicated to a single piece of vibrating equipment.
- J. No rigid connections or contact between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified. Coordinate work with other trades to avoid rigid contact with the building elements or the work of other trades.

- K. Locate isolation hangers as near to the overhead support structure as possible.
- L. Provide flexible duct connectors on duct connections to fan-containing equipment as specified in Division 23 Section "Air Duct Accessories".
- M. Thrust Restraints: Provide thrust limits (restraints), in one or more pairs, on all fans operating in excess of 4-inch w.g. total static pressure, where flexible duct connectors have lost slack due to fan movement, or where the fan movement relative to the ductwork exceeds 3/4-inch.
  - 1. Thrust restraints shall rod and angle brackets for attachment to both the equipment and duct work or the equipment and the structure. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Adjust to a maximum of 1/4-inch movement during start and stop of fans.

### 3.3 ADJUSTING

- A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operations.
- B. Adjust thrust restraints for a maximum of 1/4 inch of movement at start and stop. Perform adjustments with the fans operating at the maximum anticipated system operating pressures.

END OF SECTION 230548

## SECTION 230553

### IDENTIFICATION FOR HVAC

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. This Section includes HVAC identification materials and devices.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For identification materials and devices.

##### 1.4 QUALITY CONTROL

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Coordinate colors, abbreviations, and similar features with the Client Agency's existing marking and labeling systems and match existing installations.

##### 1.5 SEQUENCING AND SCHEDULING

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Almetek Industries Inc.
  - 2. Bunting
  - 3. Craftmark Pipe Markers
  - 4. EMED Co.



5. Kolbi Pipe Marker Co.
6. Marking Services, Inc.
7. Rodgers Enterprises and Distributors Inc. (RED)
8. Seton Identification Products
9. W.H. Brady Corp.
10. Or equal as approved by the Professional.

## 2.2 IDENTIFYING DEVICES AND LABELS

- A. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive, vinyl type with permanent adhesive.
  1. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.
  2. Lettering: Manufacturer's standard preprinted captions as selected by Architect/Engineer, and approved by the Client Agency. Letters shall be no smaller than 1-1/2-inches high.
  3. Arrows: Either integrally with piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.
- B. Plastic Duct Markers: Manufacturer's standard laminated plastic.
  1. Color Coding:
    - a. Blue: Cold-air supply.
    - b. Red: Hot-air supply of a dual duct system.
    - c. Green: Outside, return, and mixed air.
    - d. Yellow: Exhaust air.
  2. Terminology and Lettering: Include direction of airflow; duct service such as supply, return, or exhaust, and size of duct.
- C. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 3 mils thick.
  1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
  2. Color: Comply with ASME A13.1, unless otherwise indicated.
- D. Engraved Plastic-Laminate Equipment Labels and Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine sub-core, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
  1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification. Letter height shall be no less than 1/4-inch.
  2. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
  3. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- E. Plastic Equipment Labels and Signs: Manufacturer's standard laminated plastic, in the following color codes:
  1. Green: Cooling equipment and components.
  2. Yellow: Heating equipment and components.

3. Brown: Energy reclamation equipment and components.
  4. Blue: Equipment and components that do not meet criteria above.
  5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
  6. Text Size: Letter height shall be no less than 1/4-inch.
- F. Plasticized Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
1. Size: 3-1/4 by 5-5/8 inches.
  2. Fasteners: Brass grommets and wire.
  3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
  4. Color: Yellow background with black lettering.
- G. Ceiling Markers: Markers shall be round, adhesive backed or push-pin type, a minimum of 7/8 inch diameter, and shall include engraving to indicate service. Place push pin type in the ceiling tiles, use adhesive backed markers on the lay in grid and on drywall ceilings.
- H. Access Panel Markers: Manufacturer's standard laminated plastic, adhesive backed, with abbreviated terms and numbers corresponding to concealed item. Black lettering on a white background. Letter height shall be no less than 1/4-inch.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Walking / head clearance hazards in mechanical room such as horizontal runs of piping or ductwork less than 6'-8" above the finished floor shall be identified according to ANSI Z535 OSHA standards.
- B. Tripping hazards in mechanical rooms shall be identified according to ANSI Z535 and OSHA standards.
- C. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated on the Drawings. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.
  1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.
- D. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.
- E. Warning-Tag Installation: Write required message on, and attach warning tags to, equipment and other items where required by OSHA standards.

### 3.2 LABELING AND IDENTIFYING PIPING SYSTEMS

- A. Install pipe markers on each system. Include arrows showing normal direction of flow, including pipes where flow is allowed in both directions.

- B. Marker Type: Plastic markers, with application systems.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg. F or higher. Where these pipes are to remain uninsulated, provide a short section of insulation.
- D. Fasten markers on pipes and insulated pipes smaller than 6 inches in diameter by one of following methods:
  - 1. Adhesive lap joint in pipe marker overlap.
  - 2. Laminated or bonded application of pipe marker to pipe or insulation.
  - 3. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 3/4 inch wide, lapped a minimum of 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
- E. Fasten markers on pipes and insulated pipes 6 inches in diameter and larger by one of following methods:
  - 1. Laminated or bonded application of pipe marker to pipe or insulation.
  - 2. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 1-1/2 inches wide, lapped a minimum of 3 inches at both ends of pipe marker, and covering full circumference of pipe.
  - 3. Strapped to pipe or insulation with manufacturer's standard stainless-steel bands.
- F. Locations: Locate pipe markers and color bands where piping is located above accessible ceilings; exposed in finished spaces; mechanical rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations according to the following:
  - 1. Within 3 ft. of each valve and control device.
  - 2. Within 3 ft. of each branch connection, excluding short takeoffs for terminal units. Mark each pipe at branch, where flow pattern is not obvious.
  - 3. Within 3 ft. of penetrations through walls, floors, ceilings, or non-accessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Within 3 ft. of major equipment items and other points of origination and termination.
  - 6. Spaced at a maximum of 25-foot intervals along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
- G. Do NOT label piping where exposed in finished spaces.

### 3.3 EQUIPMENT SIGNS AND LABELS

- A. Equipment Signs and Labels: Install and permanently fasten equipment nameplates on HVAC equipment. Locate nameplates where accessible and visible.
  - 1. Include signs and labels for all equipment and devices scheduled or tagged on the Drawings.
  - 2. Terminology: Match schedules as closely as possible. Include the following:
    - a. Name and plan number.
    - b. Equipment service.
    - c. Design capacity.
    - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

- e. Regularly required maintenance actions for equipment and systems, including the title or publication number for the operation and maintenance manual for that particular model and type of product, as required by the 2018 International Energy Conservation Code.
  - f. Air handling rooftop mounted equipment (air handlers, rooftop air conditioners, exhaust fans, etc.) and split system condensing units shall be labeled with the name(s) of the rooms or areas served.
- B. Provide warning labels or tags in a conspicuous location on all electrically powered equipment that reads "DANGER - LOCK OUT ELECTRICITY BEFORE WORKING ON EQUIPMENT".

### 3.4 LABELING AND IDENTIFYING DUCTWORK SYSTEMS

- A. Identify all ducts with duct markers; and arrows indicating service and direction of flow.
- 1. Location: Locate signs near points where ducts enter into concealed spaces, at all access panels and doors, on both sides of floor and wall penetrations, below roof penetrations, at all major changes in direction, and at maximum intervals of 30 feet.
  - 2. Label duct access doors with laminated plastic, adhesive backed markers. Text shall indicate the purpose of the door (e.g. "Fire Damper", "Inspection and Cleaning Access", etc.).
  - 3. Ducts and duct access doors exposed in finished areas shall NOT be labeled.

### 3.5 SPACE CONTROL DEVICE LABELS

- A. Label space thermostats, relative humidity sensors, carbon dioxide sensors, start/stop switches, override switches, and similar space control devices with the name/designation/number of the associated HVAC equipment / air system. For devices controlling a VAV terminal, the name of the VAV terminal only shall be indicated.
- B. Labels shall use 1/4" high black text on a white background. Labels shall be water resistant flexible plastic with adhesive backing, such as those produced by common handheld label makers. Apply labels to the device or box cover plate. Do not apply to walls or other surfaces unless approved by the Architect/Engineer.

### 3.6 CEILING AND ACCESS PANEL LABELS AND MARKERS

- A. Ceiling Markers: Provide for concealed equipment, dampers, VAV boxes, air valves, duct reheat coils, piping valves, smoke dampers, fire dampers, and combination fire/smoke dampers, duct mounted sensors, and other similar equipment, devices, and duct system accessories.
- 1. Obtain approval from the Client Agency's maintenance personnel regarding the colors to be used for each type of device.
- B. Access Panel Labels: Provide labels on wall, shaft, and ceiling access panels, outside of finished spaces only.
- C. Provide labels on the ceiling grid to identify the correct tile to be removed for filter change out access.

3.7 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.

END OF SECTION 230553

## SECTION 230593

### TESTING, ADJUSTING, AND BALANCING FOR HVAC

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 ADDITIONAL RELATED DOCUMENTS

- A. Additional related sections include:
  - 1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
  - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

##### 1.3 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems, including the following:
  - 1. Pre-Demolition Testing.
  - 2. Air Systems:
    - a. Constant-volume air systems.
    - b. Multi-zone variable-air-volume systems.
  - 3. Testing, Adjusting, and Balancing of Equipment, including, but not limited to:
    - a. Motors.
    - b. Fans, and fan-containing equipment.
    - c. Condensing units.
    - d. Heat-transfer coils.
  - 4. HVAC equipment quantitative-performance settings.
  - 5. Existing systems TAB.
  - 6. Reporting results of activities and procedures specified in this Section.

##### 1.4 ACCEPTABLE TESTING AND BALANCING AGENTS

- A. Subject to compliance with requirements, available TAB Agents that may be engaged to perform the work of this Section include, but are not limited to, the following:
  - 1. Air Balancing Engineers Inc. (Berwick PA)
  - 2. Baltronix Inc. (Langhorne PA)

3. Flood and Sterling Inc. (New Cumberland PA)
4. Peno Balancing Co. Inc. (Centre Hall PA)
5. TABworks Inc. (Hershey PA)
6. Equal as Approved by the Professional

## 1.5 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Airflow Control Terminal: Device installed in the duct system that automatically regulates the airflow rate passing through the device. (e.g. VAV boxes, air valves, etc.)
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- D. Deficiency: Any installation, measurement, or finding outside the tolerances allowed by the referenced testing and balancing procedural standards or project specifications.
- E. Diversity: In air or hydronic systems, diversity is the term used to describe the difference in air or water volume between the prime mover (fan or pump) and sum of the terminal elements.
- F. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- G. Memory Stop: An adjustable mechanical device that allows a valve to be closed (for service) and limits the valve to a predetermined position when re-opened.
- H. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- I. Report Forms: Test data sheets for recording test data in logical order.
- J. Shutoff Head: The dynamic measurement of a pump's total dynamic head at no flow. Performed by closing the pump discharge valve only.
- K. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- L. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- M. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- N. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- O. TAB (Testing, Adjusting, and Balancing): A systematic process or service applied to HVAC systems, and other environmental systems, to achieve and document air and hydronic flow rates.
- P. TAB Agent: The contractor performing the work of this Section.

- Q. Terminals: In the context of a hydronic system, a device such as a coil where heat is either removed or added to the working fluid, other than the system prime movers (chillers, cooling towers, boilers, etc.).
- R. Terminal Outlet or Inlet: A point where air, enters or leaves the ductwork distribution system. (e.g. diffuser, register, grille, etc.)
- S. Test: A procedure to determine quantitative performance of a system or equipment.
- T. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- U. AABC: Associated Air Balance Council.
- V. AMCA: Air Movement and Control Association.
- W. NEBB: National Environmental Balancing Bureau.
- X. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

## 1.6 ACTION SUBMITTALS

- A. Testing and Balancing Agent Qualifications: Verification of experience and capability of the testing and balancing agent. The purpose of this submittal is to establish, in a proactive manner, that the agent proposed by the Division 23 Contractor to perform the work of this Section is qualified. The Contractor's failure to obtain approval for this submittal prevents the Contractor from utilizing the proposed service provider. Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below. Also submit the following:
  1. Resumes of the technicians anticipated to work on this project.
    - a. Note: Do not submit 'generic' firm resumes or resumes of firm principals unless those individuals are proposed to do the actual testing and balancing work on site for this project.
  2. A list of projects completed for each technician within the last 12 months. Include no less than three (3) client references with contact information relevant to projects completed within the last 12 months for each technician. The same project may be used more than once if multiple technicians worked on the project.
  3. A list of any projects completed for this same Client Agency within the last 3 years, if any, along with the technicians who worked on those projects, and the Client Agency's contact information.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Certified Testing, Adjusting, and Balancing Reports: Submit reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- B. Sample Report Forms: Submit sample testing, adjusting, and balancing report forms.



## 1.8 QUALITY CONTROL

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent that is currently certified by either AABC or NEBB or TABB (Testing, Adjusting, and Balancing Bureau).
  - 1. The company / agency as a whole shall be certified, and at least one individually certified supervisor or technician shall be supervising or participating in the work at the project site at all times when testing and balancing activities are taking place.
  - 2. The individually certified supervisor or technician shall be a AABC "TBE", NEBB or TABB Certified with a minimum of eight (8) years' experience in performing HVAC system testing, adjusting and balancing, with at least four (4) of those years in a supervisory position.
  - 3. At least one of the on-site certified supervisors or technicians shall have performed work characteristic of this project on at least three (3) other similar projects within the last five (5) years.
- B. Sub-Contracting Arrangement: The Agent shall be an independent company that is not financially affiliated with the Division 23 Contractor.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
  - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing", from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or TABB / SMACNA forms.
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards or in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification" or in TABB Standards.
- F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

## 1.9 PROJECT CONDITIONS

- A. Full Client Agency Occupancy: The Client Agency will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Client Agency during testing, adjusting, and balancing operations to minimize conflicts with the Client Agency's operations.

## 1.10 COORDINATION

- A. The Division 23 Contractor shall coordinate the efforts of factory-authorized service representatives for systems and equipment, ATC System Installer, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

#### 1.11 COORDINATION WITH THE COMMISSIONING AGENT

- A. A dedicated Commissioning Agent shall be hired by the Client Agency to perform system certification and testing at the completion of construction. The TAB Agent shall assist the Commissioning Agent by supporting tasks as directed by the Commissioning Agent.
- B. Refer to Section 230800.
- C. In addition to the required work and coordination described in the above referenced Section, the TAB Agent shall:
  - 1. Coordinate all balancing activities with the Commissioning Agent, and shall perform the herein described final inspection testing work as directed by the Commissioning Agent.

#### 1.12 WARRANTY

- A. General Warranty: The project performance guarantee specified in this Article shall not deprive the Client Agency of other rights the Client Agency may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms, on NEBB or TABB forms stating that AABC, NEBB or TABB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
  - 1. The certified Agent has tested and balanced systems according to the Contract Documents.
  - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
  - 3. The warranty shall meet the requirements of the following program(s):
    - a. AABC - National Project Performance Guarantee
    - b. NEBB - Conformance Certification
    - c. TABB - International Quality Assurance Program

### PART 2 - PRODUCTS

#### 2.1 DUCT TEST HOLES AND HOLE PLUGS

- A. Refer to Division 23 Section "Air Duct Accessories" for instrument test holes for ducts constructed to pressure classes exceeding 2" w.g. positive pressure, and for ducts of welded seam and joint construction.
  - 1. The TAB Agent shall review the Division 23 Contractor's ductwork shop drawings and shall prescribe the location, spacing, and quantity of all required instrument test holes.

- B. For ducts not utilizing welded seam and joint construction and for those constructed for 2" w.g. positive pressure class or less, the TAB Agent shall provide tapered, round LDPE plastic plugs with center pull-tabs to seal holes drilled in ductwork for measuring purposes. Provide Caplugs "CPT" series or approved equal. Holes drilled in ducts shall be no larger than 1/2" diameter.

### PART 3 - EXECUTION

#### 3.1 TESTING, ADJUSTING, AND BALANCING SCOPE

- A. Pre-Demolition Testing:
  - 1. Perform airflow performance testing of air system serving 411.
- B. Post-Construction Airflow Balancing: Include in the airflow adjustment and balancing scope, no less than the following:
  - 1. All new systems and new equipment.
  - 2. All existing system fans (e.g. independent fans, fans in air handling equipment, etc.) associated with ductwork systems that have been altered under the Project to any degree.

#### 3.2 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
  - 1. Verify that balancing devices, such as manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
  - 2. Identify locations where instrument test holes are required and coordinate with the sheet metal shop drawings and coordination drawings so that the required test holes are installed prior to beginning testing and balancing operations.
  - 3. Examine the project phasing plans.
- B. Examine approved submittal data of HVAC systems and equipment.
  - 1. Verify the balancing and/or flow verification requirements of the equipment provided with the manufacturers or manufacturer's representatives.
- C. Examine equipment performance data, including fan curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 1. Calculate airflow system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine system and equipment test reports.
- F. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- G. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- H. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine airflow control terminal units, such as variable air volume boxes, and fan coil and heat pump units, to verify that they are accessible and their controls are connected and functioning.
- J. Examine equipment for installation and for properly operating safety interlocks and controls.
- K. Examine automatic temperature system components to verify the following:
  - 1. Dampers and other controlled devices operate by the intended controller.
  - 2. Dampers are in the position indicated by the controller.
  - 3. Integrity of dampers for free and full operation and for tightness of fully closed and fully open positions.
  - 4. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  - 5. Sensors are located to sense only the intended conditions.
  - 6. Sequence of operation for control modes is according to the Contract Documents.
  - 7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
  - 8. Interlocked systems are operating.
  - 9. Changeover from heating to cooling mode occurs according to design values.

### 3.3 PREPARATION

- A. Complete system readiness checks. Verify, at the minimum, the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Manual balance dampers are open.
  - 5. Pressure independent automatic balancing dampers/terminals have been pre-set to the required airflow rates.
  - 6. Fire and smoke dampers are open.
  - 7. Ceilings are installed in areas where air-pattern adjustments are affected by the ceiling.
  - 8. Air terminal inlets and outlets (grilles, diffusers, etc.) have been fitted with their specified accessories, such as dampers, neck baffles, and control grids, and have been adjusted to the required throw pattern.
  - 9. Access to balancing devices is provided.
  - 10. Windows and doors can be closed so design conditions for system operations can be met.
  - 11. Variable-frequency controller startup is complete and safeties are verified.
  - 12. Fans are operating, free of vibration, and rotating in the correct direction.

### 3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in the latest edition of AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or TABB's "Quality Assurance Program for Environmental Systems Balance", and this Section.
  - 1. The content of this Section shall be considered supplemental to the referenced standards, however in the event of a direct conflict between the methods prescribed by this this Section and those contained in the referenced standards, the TAB Agent shall request a clarification from the Architect / Engineer. The higher cost method / procedure shall be carried in the bid price.
- B. Access and Repair: Cut insulation on ducts to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes as specified elsewhere in this Section and patch insulation and jacketing with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
  - 1. Do not cut or otherwise penetrate equipment cabinets or the top of exterior ducts unless specifically permitted to do so by the Architect / Engineer.
- C. Final Setting Marks: Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, fan-speed-control dials, and similar controls and devices, to show final settings.
- D. Provide all instruments, equipment, and materials needed for tests.

### 3.5 RE-TESTING

- A. If any deficiency in the installation of the work discovered during initial TAB operations prevents complete, accurate, and uncompromised testing, adjusting, and balancing of the systems, the TAB Agent shall report the deficiencies in writing. Any preliminary balancing work done with the deficiency still present shall will not be sufficient for acceptance, and re-testing and balancing shall be required after the deficiency has been fully corrected by the Contractor.
- B. If the fan and motor sheaves furnished with the fan prove to be inadequate for properly balancing the fan, the Division 23 Contractor shall replace the sheaves at no additional Cost to the Client Agency, and the TAB agent shall re-test and balance the fan with the new sheaves.

### 3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For multiple zone variable-air-volume systems, develop a plan to simulate diversity.

- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
  - 1. Do not use readouts from airflow measuring stations as report data. The Agent shall independently measure airflow rates.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.
- M. Place systems in operation with filters installed and control systems complete and operating. Temporarily block filters to simulate dirty filter pressure drop (obtain dirty filter pressure drop from drawing schedules. If not stated, contact design engineer to obtain). Balance systems to design ratings.
- N. Check flow rates for airflow control terminal units (e.g. VAV boxes) and reset if found to be incorrect.
- O. Verify flow rates through pressure independent automatic balancing dampers/terminals . If found to be incorrect, verify the device setting and adjust as required. If this does not correct the deficiency, measure the differential pressure across the device.
- P. On multiple zone variable-air-volume systems, determine the lowest practical supply duct static pressure setpoint while maintaining required pressure at the most aerodynamically remote control air terminal units (e.g. VAV box). Set static pressure set points to ensure the most hydraulically remote terminal unit(s) can achieve design flow. Measure flow at each terminal unit individually to verify scheduled design flow is achieved at the lowest possible differential pressure set point. Reset the duct pressure set point and re-measure flow at each terminal unit until the lowest set point is achieved. Coordinate with DDC system sub-contractor's programmer.
- Q. Verify the accuracy and calibration of air flow measuring stations by taking traverse readings across associated ducts, or other measurements as required.
  - 1. Do not use readouts from airflow measuring stations as report data. The Agent shall independently measure airflow rates.
- R. Variable Speed Drive Adjustments: Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment" for additional information related to variable frequency drive tests and setting adjustments.
  - 1. For belt-drive fans equipped with variable frequency drives (VFDs), set the drive output to 60 hertz and adjust the belt-drive sheaves to achieve the scheduled (design) fan performance.

- a. Determine and record the maximum output frequency that results in operation of the motor at 95% of the motor nameplate ampacity.
  - b. Report the recorded test results to the Engineer.
  - c. Re-set the VFDs maximum output speed to the value recommended by the Architect / Engineer.
  - d. Verify that the final settings corresponds to, or is lower than, the maximum RPM for the fan wheel class, and will prevent motor overload in normal operation.
2. For direct-drive fans equipped with variable frequency drives, determine the output frequency of the drive required to achieve the scheduled (design) fan performance.
- a. Note that that the required output frequency is very often above 60 Hz.
  - b. Record the required output frequency at the design fan performance and measure voltage and amps of the motor for each phase.
  - c. Additionally, determine and record the maximum output frequency that results in operation of the motor at 95% of the motor nameplate ampacity or operation of the fan just above breakdown torque of the motor, whichever is reached first.
  - d. Report the recorded test results to the Engineer.
  - e. Re-set the VFDs maximum output speed to the value recommended by the Architect / Engineer.
  - f. Verify that the final settings corresponds to, or is lower than, the maximum RPM for the fan wheel class, and will prevent motor overload in normal operation.
- S. Speed adjustment procedures for ECM motors controlled through an analog output from the DDC system shall be similar to that described above for direct drive fans powered through VFDs.
1. Use clamp-type electric meters that are capable of properly measuring non-linear current. Erroneous reading will occur otherwise.

### 3.7 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
  3. Compare contractor document values with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
  5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Where present, adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets (e.g. grilles and diffusers) and calculate the total airflow for that zone.
  2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminal inlets and outlets.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.8 PROCEDURES FOR MULTIPLE-ZONE VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all airflow control terminal units (e.g. VAV boxes) is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Calibrate system airflow measuring stations. If the airflow station manufacturer does not recommend field calibration, perform readings to verify that the stations are approximately accurate.
- C. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Verify that the system is under static pressure control.
  2. Select the airflow control terminal unit (e.g. VAV box) that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point



- so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Calibrate and balance each airflow control terminal unit for maximum and minimum design airflow as follows:
    - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    - d. Adjust controls so that terminal is calling for minimum airflow.
    - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    - f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
    - g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
  4. After airflow control terminal units have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
    - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
  5. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report any artificial loading of filters at the time static pressures are measured.
  6. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
    - b. Verify that airflow control terminal units are meeting design airflow under system maximum flow.

7. Re-measure the inlet static pressure at the most critical airflow control terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
8. Verify final system conditions as follows:
  - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - b. Re-measure and confirm that total airflow is within design.
  - c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
  - d. Mark final settings.
  - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
  - f. Verify tracking between supply and return / relief fans.

### 3.9 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller (where present) to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

1. Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment" for VFD start up, testing, and adjustment requirements.

### 3.10 PROCEDURES FOR CONDENSING UNITS AND HEAT PUMP UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

### 3.11 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Air Systems:
  - a. Measure and record the operating speed, airflow, and static pressure of each fan.
  - b. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  - c. Check the condition of filters.

- d. Check the condition of coils.
  - e. Check the operation of the drain pan and condensate-drain trap.
  - f. Check bearings and other lubricated parts for proper lubrication.
  - g. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing air distribution systems, inspect existing fans and air handling equipment that is to remain and be reused to verify that existing fans and air handling equipment has been cleaned and refurbished. Verify the following:
- 1. New filters are installed.
  - 2. Coils are clean and fins combed.
  - 3. Drain pans are clean.
  - 4. Fans are clean.
  - 5. Bearings and other parts are properly lubricated.
  - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing air distribution systems to the extent that existing systems are affected by the renovation work. Also refer to the Drawings for additional required balancing scope of existing systems.
- 1. Air Distribution Systems: Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  - 2. If calculations increase or decrease the air flow rates by more than 5 percent, make primary equipment (e.g. fan or pump) adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.

### 3.12 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
- 1. Fans and Equipment with Fans: Zero to plus 10 percent, when tested with filter pressure drop simulated at dirty conditions.
  - 2. Air System Minimum Outdoor Air Intake: 100% to 110% of design.
  - 3. Air Outlets and Inlets (Diffusers and Grilles): Minus 10 percent to plus 10 percent.
  - 4. Terminal Units (e.g. VAV boxes, air valves, etc.): Minus 5 percent to plus 5 percent.

### 3.13 PROGRESS REPORTING

- A. Pre-Demolition Measurements and Tests Report.

### 3.14 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
- 1. Include a list of instruments used for procedures, along with proof of calibration.

- C. Final Report Contents: In addition to report data specified in paragraphs below, include the following:
1. Fan curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance, but do not include entire Shop Drawings and Product Data submittals.
  5. Equipment physical data described below, where such data is not included in the Contractor's approved submittal. (i.e. data listed below that is included in the approved submittal does not need to be repeated in the Final Report). Do not include entire Shop Drawings and Product Data submittals.
  6. All required measurements and tests described in Articles above, but not listed in paragraphs below.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
  2. Name and address of TAB firm.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB firm who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for airflow control terminal units, including manufacturer, type size, and fittings.
  14. Notes to explain why certain final data in the body of reports varies from indicated values.
  15. Test conditions for fans performance forms including the following:
    - a. Settings for outside-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils and other heat exchange devices.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Settings for supply-air static-pressure controller.
    - g. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
  2. Duct, outlet, and inlet sizes.
  3. Airflow control terminal units.
  4. Airflow terminal inlets and outlets.
  5. Balancing stations.

6. Position of balancing devices.
- F. Air-Handling Unit and Similar Air System Equipment Test Reports: For -air systems with heat transfer devices (coils, etc.) include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    - j. Number of belts, make, and size.
    - k. Number of filters, type, and size.
  2. Motor Data:
    - a. Make and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
  3. Air-Side Test Data (Indicated and Actual Values), with pressures and airflow rates presented on a diagram of the unit:
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Filter static-pressure differential in inches wg.
    - f. Preheat coil static-pressure differential in inches wg.
    - g. Cooling coil static-pressure differential in inches wg.
    - h. Re-heating coil static-pressure differential in inches wg.
    - i. Outside airflow in cfm.
    - j. Return airflow in cfm.
    - k. Outside-air damper position.
    - l. Return-air damper position.
- G. Refrigerant-Coil Test Reports: As a supplement to the report for the associated air system, for refrigerant coils installed in packaged AC units and similar equipment, include the following:
1. Coil Data:
    - a. System identification.
    - b. Location.
    - c. Coil type.

2. Test Data (Indicated and Actual Values):
  - a. Airflow rate in cfm.
  - b. Air pressure drop in inches wg.
  - c. Outdoor-air, wet- and dry-bulb temperatures in deg F.
  - d. Return-air, wet- and dry-bulb temperatures in deg F.
  - e. Entering-air, wet- and dry-bulb temperatures in deg F.
  - f. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - g. Refrigerant expansion valve and refrigerant types.
  - h. Refrigerant suction pressure in psig.
  - i. Refrigerant suction temperature in deg F.
  
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
  1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
    - g. Sheave make, size in inches, and bore.
    - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
  
  2. Motor Data:
    - a. Make and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    - g. Number of belts, make, and size.
  
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Suction static pressure in inches wg.
  
- I. Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
  1. Report Data:
    - a. System, fan and air-handling unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft..
    - g. Indicated airflow rate in cfm.

- h. Indicated velocity in fpm.
- i. Actual airflow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.

J. Air-Terminal-Device Reports (Grilles, Diffusers, etc.):

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Test apparatus used.
- d. Area served.
- e. Air-terminal-device make.
- f. Air-terminal-device number from system diagram.
- g. Air-terminal-device type and model number.
- h. Air-terminal-device size.
- i. Air-terminal-device effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Air velocity in fpm.
- c. Preliminary airflow rate as needed in cfm.
- d. Preliminary velocity as needed in fpm.
- e. Final airflow rate in cfm.
- f. Final velocity in fpm.
- g. Space temperature in deg F.

K. Airflow Control Terminal (e.g. VAV box) Reports:

1. Unit Data:

- a. Make and Model Number
- b. System and air-handling unit identification.
- c. Location and Room(s) served.
- d. Inlet duct size.
- e. Supply outlet numbers connected from system diagram.

2. Test Data (Indicated and Actual Values):

- a. Heating minimum airflow rate in cfm
- b. Cooling minimum airflow rate in cfm
- c. Maximum (cooling) airflow rate in cfm
- d. Induced air cfm (if fan powered) during fan operation at each of the above primary air states in cfm.
- e. Static pressure drop through terminal (including coil, if present) at maximum airflow. Minimum and maximum flow calibration factors determined for the unit inlet velocity sensor.

L. Refrigerant Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air cooled condensers, and air-cooled condensing units include the following:

1. Unit Data:
  - a. Unit identification.
  - b. Location.
  - c. Unit make and model number.
  - d. Compressor make.
  - e. Compressor model and serial numbers.
  - f. Refrigerant type and weight in lb.
  - g. Low ambient temperature cutoff in deg F.
  
2. Test Data (Indicated and Actual Values):
  - a. Inlet-duct static pressure in inches wg.
  - b. Outlet-duct static pressure in inches wg.
  - c. Entering-air, dry-bulb temperature in deg F.
  - d. Leaving-air, dry-bulb temperature in deg F.
  - e. Control settings.
  - f. Unloader set points.
  - g. Low-pressure-cutout set point in psig.
  - h. High-pressure-cutout set point in psig.
  - i. Suction pressure in psig.
  - j. Suction temperature in deg F.
  - k. Condenser refrigerant pressure in psig.
  - l. Condenser refrigerant temperature in deg F.
  - m. Oil pressure in psig.
  - n. Oil temperature in deg F.
  - o. Voltage at each connection.
  - p. Amperage for each phase.
  - q. Kilowatt input.
  - r. Crankcase heater kilowatt.
  - s. Number of fans.
  - t. Condenser fan rpm.
  - u. Condenser fan airflow rate in cfm.
  - v. Condenser fan motor make, frame size, rpm, and horsepower.
  - w. Condenser fan motor voltage at each connection.
  - x. Condenser fan motor amperage for each phase.

M. Instrument Calibration Reports:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

3.15 VERIFICATION OF FINAL REPORT

- A. The Professional reserves the right to require a verification of the final report.
- B. TAB firm test and balance engineer shall conduct the verification in the presence of Professional.



- C. Professional shall randomly select measurements documented in the final report to be rechecked.
  - 1. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day on-site, whichever is less.
- D. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- E. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- F. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
- G. A second final inspection will be performed. If the second final inspection also fails, Client Agency shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

#### 3.16 ADDITIONAL TESTS

- A. After acceptance of the final balancing report, and within one year of substantial completion, provide up to 4 hours of on-site time for additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions. This allowance may be required over as many as two (2) separate site visits. ]"Additional testing and balancing" meaning work not otherwise required by the Contract Documents.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

## SECTION 230713

### HVAC DUCT INSULATION

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 ADDITIONAL RELATED DOCUMENTS

- A. Additional related sections include:
  - 1. Division 23 Section "Common Work Results for HVAC" for definitions of some terms used in this Section.
    - a. Definition of the term 'Mixed Air': An airstream containing, in some or all system operating modes, a fraction of outdoor air mixed with return air.

##### 1.3 SUMMARY

- A. This Section includes duct and plenum insulation; field-applied jackets; accessories and attachments; and sealing compounds.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Removable insulation sections at access panels.
  - 2. Application of field-applied jackets.
  - 3. Applications at dampers and other control devices.
  - 4. Insulation terminations and sealing of insulation at manual volume damper standoff brackets.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

## 1.6 QUALITY CONTROL

- A. Installer Qualifications: Skilled mechanics who have successfully completed a craft training program offered by the Contractor, insulation material manufacturer, or trade association relating to the installation of duct insulation for commercial, industrial and institutional applications. Installers shall also have no less than one (1) year of relevant experience.
- B. Installation Standards: The application of insulation shall conform to the Midwest Insulation Contractors Association's (MICA) "*National Commercial and Industrial Insulation Standards*", 8th Edition, except where the content of this Section conflicts.
- C. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer material containers with appropriate markings of applicable testing and inspecting agency.
  - 1. Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, for all insulation and jacketing materials used indoors.
- D. Minimum Insulation Thicknesses and R-Values: Conform to requirements of ASHRAE Standard 90.1-2016 and the 2018 International Energy Conservation Code (IECC), or the requirements of this Section, whichever is most demanding.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. Protect materials from dirt and water. If insulation materials are dirtied or wetted, they shall not be installed, or shall be removed from the ductwork if wetted or soiled after installation.

## 1.8 COORDINATION

- A. Coordinate clearance requirements for insulation application during the preparation of ductwork shop drawings and coordination drawings, and during ductwork system installation.

## 1.9 SCHEDULING

- A. Schedule insulation application after successful leakage and pressure testing duct systems, and acceptance by the Architect / Engineer. Insulation application may begin only on segments of ducts that have satisfactory test results.
- B. Schedule the application of insulation on cold duct systems to occur during the winter months, or with the cooling system de-energized. Substrates shall be completely dry at the time of application. Do not restore cooling service until the insulation installation is complete.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Glass Mineral-Fiber Insulation:
    - a. CertainTeed Corp.
    - b. Johns Manville, Inc.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens-Corning Fiberglas Corp.
    - f. Or equal as approved by the Professional.

### 2.2 INSULATION MATERIALS

- A. General Requirements: All insulation materials shall comply with the following:
1. Products shall not contain asbestos, lead, mercury, or mercury compounds.
  2. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
  3. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
  4. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- B. Glass Mineral-Fiber Board Thermal Insulation for Interior Use: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, 3.0 PCF density, with a factory applied white, paintable, all-service jacket (ASJ) manufactured from kraft paper, fiberglass reinforcing scrim, and aluminum foil backing, complying with ASTM C 1136, Type I.
1. 3.0 PCF materials shall have a maximum thermal conductivity of 0.23 Btu-in./h-ft<sup>2</sup>- °F.
  2. Conductivity ratings shall be at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
- C. Glass Mineral-Fiber Board Thermal Insulation for Exterior Use: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, 6.0 PCF density, with a factory applied foil faced (FSK) jacket manufactured from aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
1. 6.0 PCF materials shall have a maximum thermal conductivity of 0.22 Btu-in./h-ft<sup>2</sup>- °F.
  2. Conductivity ratings shall be at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
  3. Compressive Strength: 200 lb./sq. ft. at 10% deformation, when tested in accordance with ASTM C 165.
- D. Glass Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type III, 3/4 PCF density, without facing and with aluminum, foil-scrim-kraft (FSK) jacket manufactured from kraft paper backing, reinforcing fiberglass scrim, and aluminum foil; complying with ASTM C 1136, Type II.

1. 1-1/2 PCF materials shall have a maximum thermal conductivity of 0.24 Btu-in./h-ft<sup>2</sup>- °F.
2. 3/4 PCF materials shall have a maximum thermal conductivity of 0.29 Btu-in./h-ft<sup>2</sup>- °F.
3. Conductivity ratings shall be at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

## 2.3 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd.
  1. Tape Width: 4 inches.
- B. Bands: 3/4-inch-wide, in one of the following materials compatible with jacket:
  1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
  2. Galvanized Steel: 0.005 inch thick.
  3. Aluminum: 0.007 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
  1. Welded Pin Holding Capacity: 100 lb. for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
  1. Adhesive: Single component moisture curing adhesive recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.
  2. Peel and stick (self-adhesive) type pins are not acceptable.

## 2.4 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040-inch thick, minimum 2 by 2 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## 2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Ensure that insulation is clean and dry, and in good mechanical condition with all factory applied vapor or weather barriers intact and undamaged.
- B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements during and after installation for a minimum period of 24 hours.
- C. On cold surfaces where a vapor barrier is required (e.g. supply ductwork), insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- D. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- E. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- F. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- G. Apply multiple layers of insulation with longitudinal and end seams staggered.
- H. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- I. Keep insulation materials dry during application and finishing.
- J. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- K. Apply insulation with the least number of joints practical.
- L. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

- M. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
  - N. Insulation Terminations and Penetrations: For insulation application where vapor retarders are indicated, seal ends and cut penetrations with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - O. Install corner angles on external corners of insulation on ductwork in exposed mechanical or finished spaces and outside the building before covering with jacketing.
  - P. Apply insulation with integral jackets as follows:
    - 1. Pull jacket tight and smooth.
    - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
    - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
  - Q. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
  - R. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
    - 1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
    - 2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
  - S. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
    - 1. Seal penetrations with vapor-retarder mastic.
    - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
    - 3. Seal insulation to roof flashing with vapor-retarder mastic.
  - T. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
  - U. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
  - V. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
    - 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.
- 3.4 GLASS MINERAL-FIBER INSULATION INSTALLATION
- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives to duct, plenum, fittings and transitions surfaces according to manufacturer's recommended coverage rates.
  2. Install anchor pins and speed washers on all four sides of horizontal ducts and all four sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3-inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3-inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not over-compress insulation during installation.
  3. Impale insulation over anchors and attach speed washers.
  4. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
  6. Overlap un-faced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
  7. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  8. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
  9. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- B. Board Applications for Ducts and Plenums: Secure board insulation with adhesive and anchor pins and speed washers on all sides of ducts and plenums.
1. Apply adhesives to duct, plenum, fittings and transitions surfaces according to manufacturer's recommended coverage rates.
  2. Space anchor pins as follows:
    - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3-inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3-inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not over-compress insulation during installation.
  3. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
  5. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and



inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulation on round and flat oval duct shall be back-scored to conform to duct profile.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

### 3.5 DUCT SYSTEM APPLICATIONS - GENERAL REQUIREMENTS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Field-insulate the following plenums and duct systems listed below, and those listed in the application schedule articles located elsewhere in this Section:
  1. Indoor concealed supply-mixed air-, and outside-air ductwork.
  2. Indoor exposed supply-, mixed air-, and outside-air ductwork.
  3. All ductwork located outdoors and exposed to weather.
  4. Ducts scheduled to receive insulation in the schedules at the end of this Section.
- C. Insulate, as specified for the connecting ductwork, the outside of damper frames, silencers, duct coil casings, and similar duct accessories and equipment that form an air conveying portion of the duct wall, except for access doors and smoke, fire, and combination smoke-fire damper sleeves.
- D. Items Not Field-Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
  1. Factory-insulated flexible ducts.
  2. Factory-insulated plenums, casings, air terminal units (i.e. VAV boxes), and filter boxes and sections.
  3. Flexible connectors.
  4. Vibration-control devices.
  5. Testing agency labels and stamps.
  6. Nameplates and data plates.
  7. Factory insulated access panels and doors in air-distribution systems.
  8. Motorized damper shafts and manual volume damper quadrants.
  9. Life Safety Damper sleeves unless required by the damper's UL listing or installation instructions.

### 3.6 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Refer to Division 23 Section "Common Work Results for HVAC" for definitions of 'conditioned' and 'unconditioned' spaces, as well as 'exposed' and 'concealed' installations.
- B. Minimum R-Values scheduled below are in units of h-ft<sup>2</sup>- °F./ Btu, at 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518. For blanket insulation, they shall be 'as-installed' R-values and thicknesses with 25% compression.
  1. Provide additional insulation thickness than the minimum thicknesses scheduled below if required to meet the minimum R-value indicated.

- C. Service: Supply-air, mixed air, and outside-air ducts, concealed in indirectly conditioned spaces (e.g. ceiling plenums, shafts, etc.).
1. Material: 1-1/2 PCF glass mineral-fiber blanket with aluminum foil-scrim-kraft (FSK) jacket.
  2. Minimum Thickness: 1-1/2 inches.
  3. Number of Layers: One.
  4. Vapor Retarder Required: Yes.
  5. Minimum R-Value: 4.8.
- D. Service: Supply-air, mixed air, and outside-air ducts, exposed in Mechanical Equipment Rooms and similar un-finished, but indirectly conditioned, spaces.
1. Material: Rigid glass mineral-fiber board, 3 PCF density, with white, paintable all-service jacket (ASJ). Insulation on round and flat oval duct shall be back-scored to conform to duct profile.
  2. Minimum Thickness: 1-1/2 inches.
  3. Number of Layers: One.
  4. Vapor Retarder Required: Yes.
  5. Minimum R-Value: 6.5.
- E. Service: Supply-air, mixed air, and outside air ducts, exposed in finished, conditioned spaces.
1. Material: Rigid glass mineral-fiber board, 3 PCF density, with white all-service (ASJ) jacket. Insulation on round and flat oval duct shall be back-scored to conform to duct profile.
  2. Minimum Thickness: 1-1/2 inches.
  3. Number of Layers: One.
  4. Vapor Retarder Required: Yes.
  5. Minimum R-Value: 6.5.
- F. Service: Supply-air, return-air, mixed air, and outside air ducts, located in unconditioned spaces such as lofts, attics, and crawl spaces.
1. Material: 1-1/2 PCF mineral-fiber blanket with aluminum foil-scrim-kraft (FSK) jacket.
  2. Minimum Thickness: 3 inches.
  3. Number of Layers: One or two. If two layers are used, the inner layer shall be un-faced / un-jacketed.
  4. Vapor Retarder Required: Yes.
  5. Minimum R-Value: 9.6.
- G. Service: Portions of exhaust duct and plenum systems between an isolation motorized or backdraft damper and the duct system termination at a louver, gravity ventilator, gooseneck, or similar discharge opening to the exterior.
1. Insulate as specified above for outdoor air ductwork.

END OF SECTION 230713

## SECTION 230719

### HVAC PIPING INSULATION

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 ADDITIONAL RELATED DOCUMENTS

- A. Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for requirements related to pipe insulation shields, thermal-hanger shields and shield inserts, and protection saddles.

##### 1.3 SUMMARY

- A. This Section includes pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
  - 2. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

##### 1.5 QUALITY CONTROL

- A. Installer Qualifications: Skilled mechanics who have successfully completed a craft training program offered by the Contractor, insulation material manufacturer, or trade association relating to the installation of pipe insulation for commercial, industrial and institutional applications. Installers shall also have no less than one (1) year of relevant experience.
- B. Installation Standards: The application of insulation shall conform to the Midwest Insulation Contractors Association's (MICA) "National Commercial and Industrial Insulation Standards", 8th Edition, except where the content of this Section conflicts.
- C. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable

to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

D. Minimum Insulation Thicknesses and R-Values: Conform to requirements of ASHRAE Standard 90.1-2016 and the 2018 International Energy Conservation Code (IECC), or the requirements of this Section, whichever is most demanding.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

B. Protect materials from dirt and water. If insulation materials are dirtied or wetted, they shall not be installed, or shall be removed from the piping if wetted or soiled after installation.

## 1.7 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements for insulation application during the preparation of piping shop drawings and coordination drawings, and during piping system installation..

## 1.8 SCHEDULING

A. Schedule insulation application after testing piping systems. Insulation application may begin on segments of piping that have satisfactory test results.

B. Schedule the insulation application of refrigerant and other below-ambient piping systems to occur during the winter months, or with the cooling system de-energized. Substrates shall be completely dry at the time of application. Do not restore cooling service until the insulation installation is complete.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flexible Elastomeric Insulation:

- a. Armacell LLC.
- b. K-Flex USA.
- c. AeroFlex USA Inc.
- d. Or equal as approved by the Professional.

## 2.2 INSULATION MATERIALS

- A. General Requirements: All insulation materials shall comply with the following:
1. Products shall not contain asbestos, lead, mercury, or mercury compounds.
  2. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
  3. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
  4. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- B. Flexible Elastomeric Thermal Insulation: EPDM-based, closed-cell, flexible elastomeric insulation. NBR/PVC based insulation materials are not acceptable. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. 25/50 flame spread and smoke developed rating in accordance with ASTM E84. The material shall be rated for continuous service temperatures as high as 250 deg. F.
1. Water Vapor Permeance: 0.08 perms, maximum, as per ASTM E96 - Procedure A (dry cup).
  2. Adhesive: As recommended by insulation material manufacturer.
  3. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
  4. Materials shall have a maximum thermal conductivity of 0.265 Btu-in./h-ft<sup>2</sup>- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

## 2.3 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd.
1. Tape Width: 4 inches.
- B. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

## 2.4 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.
- B. Do not apply insulation to wet surfaces.

### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply multiple layers of insulation with longitudinal and end seams staggered.
- F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- G. Keep insulation materials dry during application and finishing.
- H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Apply insulation with the least number of joints practical.
- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

- L. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- M. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- N. Apply insulation with factory-applied jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Circumferential Joints: Cover with 3-inch-wide butt strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c. For below-ambient services, apply vapor-barrier mastic over staples.
    - a. Exception: Do not use staples on insulation for which a full adhesive closure systems is specified.
  - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
    - a. Exception: Do not staple longitudinal laps on below ambient services.
  - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
  - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
  - 1. Seal penetrations with vapor-retarder mastic.
  - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
  - 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- P. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- Q. Below Grade Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

- S. Fire-Rated Wall and Partition Penetrations: Apply insulation at penetrations of fire-rated walls, and partitions to conform to applicable UL requirements. Seal with firestop material.
- T. Floor Penetrations: Apply insulation at penetrations of floor assemblies to conform to applicable UL requirements. Seal with firestop material.
  - 1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

### 3.4 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Seal all seams, butt joints, termination points, and open ends with the manufacturer's approved sealant to prevent air / moisture intrusion.
- B. Apply vapor retarder to ends of insulation at intervals not exceeding 12 feet to form a vapor retarder / water dam between pipe insulation segments to prevent extended moisture migration should the vapor barrier in one segment become compromised.
- C. Apply insulation to straight pipes and tubes as follows:
  - 1. Follow manufacturer's written instructions for applying insulation.
  - 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation to flanges as follows:
  - 1. Apply pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
  - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- E. Apply insulation to fittings and elbows as follows:
  - 1. Apply mitered sections of pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- F. Apply insulation to valves and specialties as follows:
  - 1. Apply pre-formed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
  - 2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For strainers, fabricate removable sections of insulation arranged to allow access to strainer basket.
  - 3. Apply insulation to flanges as specified for flange insulation application.
  - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.



### 3.5 FINISHES

- A. Paint insulation and jacket as specified in Division 09 Section "Painting."
  - 1. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- B. Flexible Elastomeric Thermal Insulation: Where located outdoors or where exposed in mechanical rooms, after adhesive has fully cured, apply two (2) coats of the insulation manufacturer's recommended vinyl acrylic protective coating prior to applying any specified field-applied jackets. The coating shall have a white color and shall be K-Flex '374 Protective Coating', or approved equal. Perform surface preparation and cleaning and coating application in strict accordance with the manufacturers recommendations.

### 3.6 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not field-apply insulation to the following systems, materials, and equipment:
  - 1. Vibration-control devices.
  - 2. Do not insulate the portion of valves and other pipeline appurtenances that the manufacturer has specifically recommended against insulating.
- C. Insulate fittings and flanges as per the connecting piping.
- D. Insulate and jacket shut off valves (e.g. ball, gate, butterfly, etc.), unions, temperature control valves, strainers, check valves, and similar pipeline appurtenances as per the connecting piping.
- E. Provide labels on piping jacketing at check valves, unions, and other obscured appurtenances so their locations can be identified afterwards.

### 3.7 FIELD QUALITY CONTROL

- A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:
  - 1. Inspect fittings and valves randomly selected by Architect.
- B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.
- C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

### 3.8 INTERIOR INSULATION APPLICATION SCHEDULE

- A. This application schedule is for aboveground insulation inside the building.

- B. Refer to the "Field-Applied Jacket Application Schedule" article herein for field applied insulation jackets.
- C. Refer to the "Finishes" article herein for field applied finishes on flexible elastomeric insulation.
- D. Where a vapor retarder is indicated below, provide a fully vapor sealed installation with no voids.
- E. Service: Air conditioning condensate drain piping.
  - 1. Insulation Material: Flexible elastomeric.
  - 2. Insulation Thickness: 1/2 inch.
  - 3. Vapor Retarder Required: Yes.
- F. Service: All piping located in unconditioned loft spaces, attic spaces and crawl spaces. Refer to Division 23 Section "Common Work Results for HVAC" for definitions of 'conditioned' and 'unconditioned' spaces.
  - 1. Material: As specified above for each system.
  - 2. Thickness: 1-inch additional insulation to thicknesses specified above for each system.
  - 3. Vapor Retarder Required: As specified above for each system.
- G. Service: Refrigerant piping.
  - 1. Insulation Material: Flexible elastomeric.
  - 2. Insulation Thickness: 1-1/2 inches.
  - 3. Vapor Retarder Required: Yes.

### 3.9 EXTERIOR INSULATION APPLICATION SCHEDULE

- A. This application schedule is for above-ground insulation outside the heated and cooled envelope of the building.
  - 1. Piping located inside rooftop AHUs, rooftop AHU pipe chases, and similar locations shall be considered 'exterior' piping.
- B. Refer to the "Field-Applied Jacket Application Schedule" article herein for field applied insulation jackets.
- C. Where a vapor retarder is indicated below, provide a fully vapor sealed installation with no voids.
- D. Service: Refrigerant piping.
  - 1. Insulation Material: Flexible elastomeric.
  - 2. Insulation Thickness: 2 inches.
  - 3. Vapor Retarder Required: Yes.
  - 4. Heat Tracing Required: No.

END OF SECTION 230719

## SECTION 230800

### HVAC SYSTEMS COMMISSIONING

#### PART 1 – GENERAL

##### 1.1 STIPULATIONS

- A. The Specifications Sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 DESCRIPTION

- A. The systems that shall be commissioned in this project include but are not limited to the following:
  - 1. Ductless Heat Pump Units.
  - 2. Air Valve Boxes.
  - 3. Building Automation System (BAS).

##### 1.3 SCHEDULING

- A. The CxA will provide the initial schedule of primary commissioning events using the information gathered from the commissioning scoping meeting. The Commissioning Plan provides a format for this schedule. The timeline is fine-tuned as construction progresses. In particular, 30 days prior to startup of the primary HVAC equipment, the CxA meets with the DGS, UA and Contractors and develops a detailed commissioning schedule. The CxA will approve the commissioning schedule.
  - 1. General Contractor shall coordinate requirements of Construction Scheduling with this work.

#### PART 2 - PRODUCTS

##### 2.1 TEST EQUIPMENT

- A. The .2 Contractor shall provide all standard testing equipment required to perform startup, initial checkout, and testing requirements of Division 23.
- B. The .2 Contractor or the Controls Subcontractor shall provide all standard testing equipment required to test the control system and the HVAC packaged controls, including calibration of valve and damper actuators and all sensors. Trend logs for functional testing shall be generated through the control system, as requested by the CxA.

- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the following tolerances. Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

## PART 3 - EXECUTION

### 3.1 RESPONSIBILITIES

- A. 0.2 Contractor, Controls Subcontractor and TAB Contractor. The commissioning responsibilities applicable to each of the 0.2 Contractor, Controls Subcontractor and TAB Contractor of Division 23 are as follows:

#### *Construction and Acceptance Phases*

1. Attend the initial commissioning meeting conducted at the start of construction, the commissioning meeting held 30 days prior to startup of the primary equipment, and all commissioning team meetings.
2. Copies of approved shop drawings and startup reports for all commissioned equipment shall be submitted to the CxA through E-Builder. Supplement the shop drawing data with the manufacturer's installation and start-up procedures. This material should be identical to the literature which will be included in the Operation and Maintenance Manuals.
3. The Operation and Maintenance Manuals shall be submitted to the CxA, through E-Builder prior to the start of training (3 weeks before start-up and training and at least 60 days before substantial completion). Manuals shall include recommended operating procedures.
4. During the startup and initial checkout process, execute all portions of the manufacturer's start-up checklists, for all commissioned HVAC equipment.
5. Perform and clearly document all completed startup and system operational checkout procedures providing copies to the CxA.
6. Address current Professional punch list items and Commissioning corrective action items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.
7. Provide skilled technicians to execute starting of equipment and to perform tests in accordance with all Division 23 sections. Where specified, startup shall be performed by a factory authorized service representative. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
8. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA and Professional and retest the equipment.
9. Provide training of Using Agency's operating staff as specified in Division 23 Sections. Use expert qualified personnel.
10. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

#### *Warranty Period*

11. Correct deficiencies and make necessary adjustments to O&M manuals for applicable issues identified in any seasonal testing.

- B. 0.2 Contractor. The responsibilities of the 0.2 Contractor, during construction and acceptance phases in addition to those listed in (A) are:
1. Provide startup for all HVAC equipment.
  2. Calibrations: The .2 CONTRACTOR is responsible to calibrate all factory installed sensors and actuators. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated by the 0.2 CONTRACTOR.
  3. Supervise all commissioning activities executed by subcontractors, including the Controls Subcontractor.
  4. List and clearly identify on the as-built duct and piping drawings the locations of all flow meters, fire and smoke dampers, duct detectors, temperature sensors, relative humidity sensors, static and differential pressure sensors (air, water, and building pressure).
- C. Controls Subcontractor. The commissioning responsibilities of the Controls Subcontractor, during construction and acceptance phases in addition to those listed in (A) are:
1. Attend controls coordination meeting prior to beginning the submittal process. Meeting will include the 0.2 Contractor, the Controls Subcontractor, the Professional, the Using Agency, DGS and the CxA. Controls functions for all systems will be reviewed so the submittal process proceeds as required.
  2. Attend controls coordination meeting at the completion of the submittal process. Meeting will include the 0.2 Contractor, the Controls Subcontractor, the Professional, the Using Agency, DGS and the CxA. All sequences will be reviewed to ensure that they are per the contract documents and that all parties are in agreement.
  3. Sequences of Operation Submittals. The Controls Subcontractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
    - a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
    - b. Logic diagrams detailing the flow of information for each control algorithm. These diagrams should include all inputs, outputs, and computations.
    - c. All interactions and interlocks with other systems.
    - d. Detailed delineation of control between any packaged controls, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
    - e. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included but will generally require additional narrative).
    - f. Start-up sequences.
    - g. Warm-up mode sequences.
    - h. Normal operating mode sequences.
    - i. Unoccupied mode sequences.
    - j. Shutdown sequences.
    - k. Capacity control sequences and equipment staging.
    - l. Temperature and pressure control: setbacks, setups, resets, etc.
    - m. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
    - n. Effects of power or equipment failure with all standby component functions.
    - o. Sequences for all alarms and emergency shutdowns.
    - p. Seasonal operational differences and recommendations.
    - q. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
    - r. Schedules, if known.

- s. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. Where possible, the numbering sequence shall correspond with Section 230993 "Sequence of Operation for HVAC Controls".
4. Control Drawings Submittal:
- a. The control drawings shall have a key to all abbreviations.
  - b. The control drawings shall contain graphic schematic depictions of the systems and each component.
  - c. The schematics shall include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
  - d. Provide a full points list with at least the following included for each point:
    - 1) Controlled system
    - 2) Point abbreviation
    - 3) Point description
    - 4) Display unit
    - 5) Control point or setpoint (Yes / No)
    - 6) Input point (Yes / No)
    - 7) Output point (Yes / No)
  - e. The Controls Subcontractor shall keep the Professional, CxA, 0.2 and TAB Contractor informed of all changes to this list during programming and setup.
5. Submit a written checkout plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional testing. At minimum, the checkout plan shall include for each type of equipment controlled by the building automation system:
- a. System name.
  - b. List of devices.
  - c. Step-by-step procedures for testing each controller after installation, including:
    - 1) Process of verifying proper hardware and wiring installation.
    - 2) Process of downloading programs to local controllers and verifying that they are addressed correctly.
    - 3) Process for performing and documenting point-to-point checkout for each digital and analog input and output.
    - 4) Process of performing operational checks of each controlled component.
    - 5) Plan and process for calibrating valve and damper actuators and all sensors.
    - 6) A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
  - d. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor, controller or command has "passed" and is operating within the contract parameters.
  - e. A description of the instrumentation required for testing.
  - f. Indicate the portion of the controls checkout plan that should be completed prior to TAB using the controls system for TAB work. Coordinate with the CxA and TAB Contractor for this determination.

6. Point-to-Point Checkout: Include in the checkout plan a point-to-point checkout. Each control point tied to a central control system shall be verified to be commanding, reporting and controlling according to its intended purpose. For each output, commands shall be initiated and verified to be functioning by visually observing and documenting the status of the controlled device in the field (e.g. valve or damper actuator response, pump or fan status). For each input, the system or conditions shall be altered to initiate the input response being tested and the response in the control system observed and recorded (e.g. high duct static pressure alarm).
7. Calibrations: The CONTROLS SUBCONTRACTOR is responsible to calibrate all field installed sensors and actuators using test and documentation methods approved by the CxA. The 0.2 CONTRACTOR is responsible to calibrate all factory installed sensors and actuators.
  - a. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated by the 0.2 CONTRACTOR.
  - b. All procedures used shall be fully documented by the Controls Subcontractor on suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
8. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points as indicated in the Specifications.

### 3.2 SUBMITTALS

- A. Copies of MEP shop drawings will be provided to CxA, when they are submitted to the Professional, electronically through E-Builder. CxA will review shop drawings concurrently with the Professional and provide any comments to the Professional so they may be included in their comments. Copies of approved shop drawings and startup reports for all commissioned equipment will be forwarded to the CxA through E-Builder. Supplement the shop drawing data with the manufacturer's installation and start-up procedures. This material should be identical to the literature which will be included in the Operation and Maintenance Manuals.
- B. The CxA may request additional design narrative from the Professional and Controls Subcontractor, depending on the completeness of the basis of design documentation and sequences provided with the Specifications.
- C. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the Professional will approve them.

### 3.3 STARTUP

- A. The 0.2, Controls and TAB Contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section. Equipment start-up is required to complete systems and sub-systems so they are fully functional, in compliance with the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Agent or Department.
- B. Testing is intended to begin upon completion of a system. Refer to Section 019100 for additional information related to scheduling.

### 3.4 TESTS

- A. The 0.2 Contractor and Controls Subcontractor shall provide the necessary support to the CxA to complete functional testing. The Controls Subcontractor shall fully test and verify all aspects of the BAS Contract Work on a point / system / integrated operational basis for all points, features and functions specified. The following requirements apply to all mechanical and control systems and features that are to be commissioned when referenced below. Tests shall:
1. Verify functionality and compliance with the basis of design for each individual sequence module in the sequence of operations. Verify proper operation of all control strategies, energy efficiency and self-diagnostics features by stepping through each sequence and documenting equipment and system performance. Tests shall include startup, normal operation, shutdown, scheduled 'on' and 'off', unoccupied and manual modes, safeties, alarms, over-rides, lockouts and power failure.
  2. Verify operation of systems and components that may be impacted during low, normal and high load conditions and during combinations of environmental and interacting equipment conditions that could reasonably exist and potentially result in adverse system reaction.
  3. Verify all alarm and high and low limit functions and messages generated on all points with alarm settings.
  4. Verify integrated performance of all components and control system components, including all interlocks and interactions with other equipment and systems.
  5. Verify shutdown and restart capabilities both for scheduled and unscheduled events (e.g. power failure recovery and normal scheduled start / stop).
  6. Verify proper sequencing of heat transfer elements as required to prevent simultaneous heating and cooling, unless specifically required for dehumidification operation.
  7. Verify system response and stability of control loops under different load conditions and determine if additional loop tuning is required by the Controls Contractor.
  8. When applicable, demonstrate a full cycle from 'off' to 'on' and 'no load' to 'full load' and then to 'no load' and 'off'.
  9. Verify time of day schedules and setpoints.
  10. Verify all energy saving control strategies.
  11. Verify that all control system graphics are representative of the systems and that all points and control elements are in the same location on the graphic as they are in the field.
  12. Verify operator control of all adjustable control system points including proper access level as agreed to during the controls system demonstration.
- B. In addition to specific details, and/or standards referenced for acceptance testing indicated in other Division 23 sections, the following common acceptance criteria apply to all mechanical equipment, assemblies and features:
1. For the conditions, sequences and modes tested, the equipment, integral components and related equipment shall respond to varying loads and changing conditions and parameters appropriately as expected, according to the sequence of operation, as specified, according to acceptable operating practice and the manufacturer's performance specifications.
  2. Systems shall accomplish their intended function and performance (e.g. provide supply air and water at designated temperature and flow rate, etc., and maintain space conditions in terms of air temperature and relative humidity) at specified levels at varying conditions.
  3. Control loops shall be stable under all operating conditions. Control loops shall exhibit a quarter decay ratio type response to a step change or other upset and return to stable operation in a time frame that is reasonable and realistic for the system that they are associated with.
  4. All safety trips shall require a manual reset to allow a system restart, unless otherwise explicitly stated in the specified sequence of operation.
  5. Resetting a manual safety shall result in a stable, safe, and predictable return to normal operation by the system.



6. Safety circuits and permissive control circuits shall function in all possible combinations of selector switch positions (hand, auto, inverter, bypass, etc.).
  7. Additional acceptance criteria will be defined by the CxA when detailed tested procedures are developed.
- C. At the CxA's discretion, if large numbers or repeated deficiencies are encountered, the CxA shall suspend functional testing until the Contractor corrects the deficiencies and troubleshoots all remaining systems at issue on their own. The Contractor shall be responsible for any resulting schedule delays that increase the overall time period to complete functional testing.

### 3.5 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors shall consist of the filled out start-up, initial checkout, prefunctional checklists and test documentation in accordance with all Division 23 sections.

END OF SECTION 230800

SECTION 232300  
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 ADDITIONAL RELATED DOCUMENTS

- 1. "HVAC Piping Insulation", for insulation, jackets, and accessories.
- 2. "Hangers and Supports for Piping and Equipment", for refrigerant piping supports and hangers.

1.3 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications, including tubing, hangers and supports, fittings, isolation valves, and specialties; special-duty valves; and refrigerants. It also includes delegated design requirements.
- B. Scope of Work: The Contractor shall provide a complete and functional refrigerant piping system for systems requiring field installed refrigerant piping. The Contractor shall also provide for the detailed design of that piping system, including, but not limited to, piping quantities, pipe sizing, hangers and supports, expansion compensation, valves and other refrigerant specialties, oil traps, and the required refrigerant and oil charges. The piping design shall comply with the equipment manufacturer's recommendations and requirements.

1.4 PERFORMANCE REQUIREMENTS

- A. Refrigerant Piping System Test Pressures: As listed on a condensing unit, compressor, or compressor nameplate, as required by ASHRAE 15.

1.5 ACTION SUBMITTALS

- A. General: Submit product data for the type of tubing proposed, and for each fitting and valve type and refrigerant piping specialty specified.
  - 1. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Shop Drawings and Delegated Design: Prepare to-scale drawings showing the detailed layout of refrigerant piping, specialties, and fittings, including pipe and tube sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.
  - 1. Refrigerant piping indicated on the Drawings is schematic only. Sizes, if indicated, are for reference and initial design and coordination purposes only. The Contractor shall size all piping and design the layout and installation of the piping, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and conformance with warranties of connected equipment, and all manufacturer requirements and recommendations.
  - 2. The equipment manufacturer shall furnish all piping system requirements to the Contractor. Then pipe sizing calculations shall then be performed by the Contractor based on the shop drawing layout of the system. Calculations to determine the required amount of oil shall also be performed. The equipment manufacturer shall then review the final shop drawings and piping sizing.
- B. System Pressure and Leak Test Declaration: For systems containing 55 lbs. or more of refrigerant as required by the IMC.

## 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For refrigerant valves and piping specialties to include in the operation and maintenance manuals.

## 1.8 QUALITY CONTROL

- A. ASME Compliance: Qualify brazing and welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."
- B. Installers of refrigerant piping systems shall have EPA 608 Type II or Universal certification. EPA certification for R410A is also required for those installations using R-410A refrigerant.
- C. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- D. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."
- E. Comply with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical."

## 1.9 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of roof portals, supports, and roof penetrations. Roof specialties are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment".

## 1.10 STORAGE AND HANDLING

- A. Cover refrigerant tubing allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect tubing and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. If end caps are not present on tube bearing the "ACR" designation, clean and re-cap in accordance with ASTM B280. Protect fittings by storage inside or by durable, waterproof, above ground packaging.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Refrigerants:
    - a. Atofina Chemicals, Inc.
    - b. DuPont Company; Fluorochemicals Div.
    - c. Honeywell, Inc.; Genetron Refrigerants.
    - d. INEOS Fluor Americas LLC.
    - e. Or equal as approved by the Professional.
  - 2. Refrigerant Valves and Specialties:
    - a. Eaton Corporation; Industrial Control Div.
    - b. Henry Technologies.
    - c. Streamline, a Div. of Mueller Industries
    - d. Sporlan; a Div. of Parker Hannfin Corp.
    - e. Or equal as approved by the Professional.

### 2.2 TUBES AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR, drawn temper.
- B. Copper Fittings: ANSI/ASME B16.22, wrought-copper solder type fittings, streamlined pattern.

### 2.3 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8.
  - 1. Use Type BCuP (copper-phosphorus) alloy meeting AWS 'BCuP-3' specification (e.g. Sil-Fos 5, or approved equal) for joining copper socket fittings with copper pipe.
  - 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

### 2.4 VALVES AND SPECIALTIES

- A. Ball Valves: Minimum 700 psig working pressure and 250 deg. F. working temperature. Forged brass or bronze body, full port internally equalized ball, copper extension stubs, blowout proof

stem and sealed cap, PTFE ball seals, double stem seals, bi-directional isolation (up to full pressure rating), integral Schrader-type access port, and socket end connections.

B. Service Valves: Minimum 600-psig pressure rating, forged-brass body with copper extension stubs, brass caps, isolatable Schrader-type access port, integral ball check valve, and solder-end connections.

C. Check Valves:

1. Body: Forged brass, or cast bronze; Y-type globe pattern.
2. Bonnet: Screwed or bolted forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 600 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket.
6. Working Pressure Rating: 600 psig.
7. Maximum Operating Temperature: 240 deg F.

E. Replaceable-Core Filter Dryers: Comply with AHRI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal, as recommended by refrigeration equipment manufacturer.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 600 psig.
9. Maximum Operating Temperature: 240 deg F.

F. Liquid Accumulators: Comply with AHRI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket.
3. Working Pressure Rating: 600 psig.
4. Maximum Operating Temperature: 275 deg F.

G. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.

2. Screen: 100-mesh stainless steel.
3. End Connections: Socket.
4. Working Pressure Rating: 600 psig.
5. Maximum Operating Temperature: 275 deg F.

H. Flexible Connectors:

1. Construction: Deep pitch corrugated tubing with wire braid outer reinforcement.
2. Materials: Stainless steel or brass.
3. Working Pressure Rating: 620 psig for sizes up to 2-1/8".
4. Minimum Length: 7 inches for sizes 3/4" and smaller, and 11 inches for sizes larger than 3/4".
5. Manufacturer: Packless Metal Hose Inc., models 'VAFS' and "VAF', or approved equal.

## 2.5 REFRIGERANT

- A. ASHRAE 34, R-134a: Tetrafluoroethane.
- B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for compliance with requirements for installation tolerances and other conditions affecting performance of refrigerant piping. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Route piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. All aspects of the completed refrigerant piping system shall satisfy all recommendations and requirements of the manufacturer of the equipment to which the piping system is connected.
- C. Install refrigerant piping according to ASHRAE 15.
- D. Basic piping installation requirements are specified in Division 23 Section "Common Work Results for HVAC."
- E. Select system components with pressure rating equal to or greater than system operating pressure.
- F. Install piping in short and direct arrangement, with minimum number of joints, elbows, and fittings.
- G. Elbows shall be of the long radius type.
- H. Arrange piping to allow normal inspection and service of compressor and other equipment. Install valves in accessible locations to allow for service and inspection.

- I. Install piping with adequate clearance between pipe and adjacent walls and hangers, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- J. Insulate refrigerant suction and liquid piping with flexible elastomeric insulation. Insulate suction lines and liquid lines separately. Refer to Division 23 Section "HVAC Piping Insulation".
  - 1. Do not install insulation until system testing has been completed and all leaks have been eliminated.
- K. Install branch lines to parallel compressors of equal length, and pipe identically and symmetrically.
- L. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope of 0.4 percent downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope of 0.4 percent downward to compressor.
  - 3. Liquid lines may be installed level.
  - 4. Install traps and double risers to entrain oil in vertical runs, where recommended by the equipment manufacturer.
- M. Use fittings for changes in direction and branch connections.
- N. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- O. Reduce pipe sizes using eccentric reducer fittings installed with level side down.
- P. When brazing, remove solenoid-valve coils; remove sight glasses; and remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties. Do not apply heat near bulb of expansion valve.
- Q. Charge and purge systems, after testing, and dispose of refrigerant following ASHRAE 15 procedures.
- R. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC".

### 3.3 HANGERS AND SUPPORTS

- A. General: Hangers, supports, and anchors are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Provide according to ASME B31.5 and ANSI / MSS SP-58.
- B. Metallic pipe hangers of dissimilar material shall not come in direct contact with refrigerant piping. Utilize hangers that support the piping on the outside of the insulation.
- C. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
- D. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
- E. Pipe rollers for multiple horizontal runs, 20 feet or longer supported by a trapeze.

- F. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes, or in accordance with ANSI / MSS-SP-58, whichever is more demanding. Tube sizes are nominal or standard tube sizes as expressed in ASTM B 88.
  - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  - 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
  - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- H. Provide additional hangers at each change of direction of piping and at concentrated equipment loads.

### 3.4 PIPE JOINT CONSTRUCTION

- A. Basic pipe and tube joint construction, along with brazing filler materials, is specified in Division 23 Section "Common Work Results for HVAC."
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
  - 1. Fill pipe and fittings with a dry, inert gas (nitrogen or carbon dioxide) during brazing to prevent formation of scale.
  - 2. Utilize brazing flux compatible with filler metals.
- C. Flared and threaded compression couplings / fittings are not permitted.
- D. Connections to Heat-Sensitive Valves and Specialties: Wrap the body of the valve/specialty with a wet rag to dissipate heat. Use large enough torch to rapidly heat joint to brazing temperature. Direct flame away from existing copper to brass joints. Quench to reduce heat spread after brazing.

### 3.5 VALVE AND PIPING SPECIALTY APPLICATIONS AND INSTALLATION

- A. Furnish and install refrigerant valves and specialties according to manufacturer's written instructions and the refrigeration system manufacturer's recommendations and requirements.
- B. Piping connections to units provided with externally applied vibration isolation shall include flexible connectors.
- C. Install ball valves complying with this Section on suction and discharge of evaporator units and condensing units to allow for servicing.
  - 1. It is the intention of these specifications that all other refrigerant specialties are factory furnished with the packaged refrigeration system equipment, and installed by the Contractor. However, any specialties not furnished with the refrigeration equipment package but required to conform to the equipment manufacturer's requirements and recommendations shall be furnished and installed by the Contractor, and those specialties shall conform to the requirements of this Section.



- D. Unless explicitly required or recommended otherwise by the refrigeration equipment manufacturer, the Contractor shall provide refrigeration specialties as follows:
1. Install ball valves in suction and discharge lines of compressor.
  2. Install service valves as a means to provide gage taps at inlet and outlet of hot-gas bypass valves and strainers if gage taps are not an integral part of hot gas bypass valves and strainers.
  3. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
  4. Install ball valves on inlet and outlet side of filter dryers.
  5. Install thermostatic expansion valves as close as possible to distributors on evaporators.
    - a. Install valve so diaphragm case is warmer than bulb.
  6. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
  7. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
  8. Install safety-relief valves where required by the ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
  9. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
  10. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
    - a. Solenoid valves.
    - b. Thermostatic expansion valves.
    - c. Hot-gas bypass valves.
    - d. Compressor.
  11. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
  12. Install receivers sized to accommodate pump-down charge.

### 3.6 PIPING SYSTEM LEAK TESTING

- A. Leak test new piping. The Contractor shall perform leak tests. Advise the Client Agency and Architect/Engineer no less than 7 days in advance of testing.
- B. Test prior to installing insulation.
- C. Leak Tests and Inspections:
1. Comply with ASME B31.5, Chapter VI.
  2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  3. The means of achieving test pressure shall have a pressure-limiting or pressure-reducing device and pressure gauge on the outlet.
  4. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article in this Section.
    - a. Fill system with dry nitrogen and appropriate tracer gas to the required test pressure. All manual valves and the solenoid valves shall be open.

- b. System shall maintain test pressure at the manifold gage throughout duration of test.
  - c. Test joints and fittings with electronic leak detector having a certified sensitivity of one ounce per year. The use of ultrasonic leak detectors is also acceptable.
  - d. Remake leaking joints using new materials, and retest the isolated, repaired area until satisfactory results are achieved.
  - e. After all leaks have been repaired and retested, the entire system shall stand at the required test pressure, with all valves open, for no less than 12 hours. The pressure at the beginning and end of the test period shall be measured using the same pressure gauge and recorded.
  - f. If the pressure change is not more than a 2 psig, release the nitrogen charge to the atmosphere (make sure you have adequate ventilation), and begin the evacuation and charging process.
5. Leak Test Declaration: A certificate of the test shall be provided for all systems containing 55 lbs. of refrigerant or more in accordance with the requirements of the International Mechanical Code (IMC).

### 3.7 SYSTEM EVACUATION AND CHARGING

- A. No refrigerant shall be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.
- B. Evacuate and charge system using procedures no less stringent than the following:
  1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate the system with a vacuum pump to an absolute pressure not exceeding 1,500 microns while the system ambient temperature is above 60 deg. F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Leave the vacuum pump running for not less than one (1) hour without interruption, evacuating to an absolute pressure not exceeding 400 microns. Then, with the pump valved off from the system, and the system equalized, the vacuum level shall be recorded and held for a minimum of 6 hours with a maximum upwards drift of 100 microns permitted over that period. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.
  3. Charge system with a new filter-dryer core in charging line.
  4. Charge system with refrigerant and oil as recommended by equipment manufacturer. Add additional refrigerant and oil, as calculated, per the manufacturer's requirements. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.
- C. If the equipment manufacturer requires or recommends an evacuation method more stringent than the above, the manufacturer's procedures shall be followed.

### 3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

- C. Adjust set-point temperature of air-conditioning controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  - 1. Open shutoff valves in condenser water circuit.
  - 2. Verify that compressor oil level is correct.
  - 3. Open compressor suction and discharge valves.
  - 4. Open refrigerant valves except bypass valves that are used for other purposes.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

## SECTION 233113

### DUCTWORK

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 ADDITIONAL RELATED DOCUMENTS

1. "Vibration Controls for HVAC" for ductwork vibration isolators.
2. "HVAC Duct Insulation" for duct insulation.
3. "Air Duct Accessories" for dampers, sound-control devices, duct-mounted access doors and panels, turning vanes, flexible ducts, and other duct mounted specialties.
4. "Air Terminal Units" for control air terminals (dual duct boxes).
5. "Diffusers, Registers, and Grilles" for air inlets and outlets.
6. "Testing, Adjusting, and Balancing for HVAC" for air balancing and final adjusting of manual-volume dampers.

##### 1.3 SUMMARY

- A. This Section includes rectangular and round metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 10- to plus 10-inch w.g. Products specified herein include the following:
  1. Single-wall, rectangular ducts and fittings.
  2. Single-wall round spiral-seam ducts and formed fittings.
  3. Sealants and gaskets.

##### 1.4 INTERPRETATION OF THE DRAWINGS

- A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Ductwork indicated on the Drawings is schematic; therefore, changes in ductwork sizes and/or location shall be made when necessary to conform to project conditions. Offsets, rises, drops, and duct profile changes shall be made at no additional cost to the Client Agency. The Architect / Engineer shall be consulted for approval of duct size changes which cannot maintain the same equivalent flow area and friction rate, require a duct aspect ratio exceeding 4 to 1, or represent a fundamental change to the configuration of duct system. Proposed changes must be specifically approved in writing by Architect / Engineer prior to being implemented. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.
- B. Duct dimensions indicated on Drawings are the required clear, inside dimensions. Adjust sheet metal dimensions to account for duct liner or double wall construction. Note that, typically, the

first dimension listed on the Drawings is that of the side visible in the particular 2D view (plan, section, etc.).

- C. The Drawings schematically indicate fitting types. All proposed changes in fitting types shown on the Drawing or specified in this Section shall be approved in writing by the Architect / Engineer prior to being implemented.
- D. Turning vanes not shown on the Drawings for mitered rectangular elbows have been omitted for clarity purposes only. The Contractor shall provide turning vanes as required by this Section regardless of drawing depiction.
  - 1. At the Contractor's option, radius type elbows with 1.5 or 1.0 centerline radius to duct width ratio may be provided in lieu of mitered elbows shown on the Drawings where the duct width in the plane of change in direction is less than 14", provided that the elbow fits in the space available.
  - 2. Mitered elbows shall not be substituted for a radius type elbows shown on the Drawings unless specifically approved by the Architect / Engineer.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", 4th Edition (2021) and performance requirements and design criteria indicated in this Section, and elsewhere in the Contract Documents.
  - 1. Where the requirements of this specification Section exceed SMACNA requirements or where a prohibition of specific type of work contained in the SMACNA standard is made, the requirements of this specification Section shall take precedence.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity and wind loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", 4th Edition (2021).
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

## 1.6 ACTION SUBMITTALS

- A. Product Data: For prefabricated ductwork, duct components sealant and gasket materials.
- B. Shop Drawings: Show details of the following:
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory- and shop-fabricated ducts and fittings.
  - 3. Duct layout indicating sizes, configuration and pressure classes.
  - 4. Elevations of top and bottom of ducts.
  - 5. Dimensions of main duct runs from building grid lines.
  - 6. Fittings.
  - 7. Reinforcement and spacing.
  - 8. Seam and joint construction.
  - 9. Penetrations through fire-rated and other partitions.

10. Penetrations through the roof and exterior walls.
11. Equipment installation based on equipment being used on Project.
12. Duct accessories, including dampers and access doors.
13. Hangers and supports, including methods for duct and building attachment, and vibration isolation.
14. Control dampers, airflow measuring stations, temperature and pressure sensors, and all other control devices required. Coordinate with the work of the ATC Sub-contractor as described in Division 23 Section "Instrumentation and Control for HVAC". Locate airflow measuring stations in strict compliance with the airflow station manufacturer's installation requirements, including sufficient straight run of duct both upstream and downstream of the station.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

## 1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Refer to Division 23 Section "Common Work Results for HVAC" for additional coordination drawing requirements. Show the following:

1. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
4. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
5. Other items required to be included as per the provisions of Division 23 Section "Common Work Results for HVAC".

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements for the following:

1. Pressure and leakage tests.
2. Duct system cleanliness tests.

C. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

## 1.8 CLOSEOUT SUBMITTALS

A. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

## 1.9 QUALITY CONTROL

- A. Installer Qualifications: Skilled mechanics who have successfully completed a craft training program offered by the Contractor or SMACNA. Installers shall also have no less than one (1) year of relevant experience.
- B. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Generally, ductwork and ductwork supports shall meet the requirements of SMACNA's Publication "HVAC Duct Construction Standards--Metal and Flexible", 4th Edition (2021), and various other SMACNA Publications referenced in this specification Section. However, where the requirements of this specification Section exceed SMACNA requirements or where a prohibition of specific type of work contained within or permitted by the SMACNA standard is made, the requirements of this specification Section shall take precedence.
- C. Minimum Seal Class Requirements: Conform to requirements of 2018 International Energy Conservation Code and the referenced SMACNA standards except where these specifications exceed those requirements.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
- C. Protect shop fabricated and factory fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings with a polyethylene film with a high-tack adhesive to attach to the ductwork and accessories. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with polyethylene waterproof wrapping.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Single Wall Round Prefabricated Ducts and Fittings:
    - a. Hranec Sheet Metal Inc.
    - b. Linx Industries Inc.
    - c. McGill AirFlow LLC
    - d. MKT Metal Manufacturing
    - e. SEMCO LLC
    - f. Sheet Metal Connectors, Inc.
    - g. Spiral Manufacturing Co., Inc.
    - h. Or equal as approved by the Professional.

2. Round Prefabricated Connectors:
  - a. Ductmate Industries, Inc.
  - b. Hranec Sheet Metal Inc.
  - c. Linx Industries Inc.
  - d. McGill AirFlow LLC
  - e. MKT Metal Manufacturing
  - f. SEMCO LLC
  - g. Sheet Metal Connectors, Inc.
  - h. Spiral Manufacturing Co., Inc.
  - i. Or equal as approved by the Professional.
  
3. Sealants:
  - a. Ductmate Industries
  - b. Hardcast; a Div. of Carlisle Co.
  - c. Childers; a Div. of HB Fuller Construction Products Inc.
  - d. McGill Airflow LLC
  - e. Foster; a Div. of HB Fuller Construction Products Inc.
  - f. Or equal as approved by the Professional.
  
4. Flanged Duct Connector Systems for Rectangular Duct:
  - a. Ductmate '35' and '45' systems.
  - b. CL Ward "J" and "H" flange and corner systems.
  - c. Hardcast / Nexus "J" and "G" flange and corner systems.
  - d. Ward Industries / Hart and Cooley "FLGJ" and "FLGH" systems
  - e. Or equal as approved by the Professional.
  
5. Flanged Duct Connector Systems for Round Duct:
  - a. Ductmate 'Spiralmate'.
  - b. Or equal as approved by the Professional.

## 2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", 4th Edition (2021) for acceptable materials, material thicknesses, and duct construction methods, except as otherwise indicated or modified by this Section. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653 or ASTM A 924, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view and required to receive a paint finish. Minimum thickness permitted shall be 24 gauge, except for round spiral seam ductwork which shall have a minimum thickness of 26 gauge.
- C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches. Maximum diameter permitted is 1/2".



## 2.3 SEALANT AND GASKETS

- A. Tapes: One-step (peel and stick) pressure-sensitive duct sealing tapes, two-part tape systems, and similar sealing tapes are not permitted for sealing metal duct joints and penetrations.
- B. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL. Sealants shall be UL-181B-M listed.
- C. Indoor Duct Water-Based Joint and Seam Sealant: Synthetic latex, permanently flexible and water, mold, and mildew resistant after curing.
1. Service Application (on this Project): Indoor duct installations, except for unconditioned outdoor air ducts.
  2. Application Method: Brush-on or trowel-on to minimum 1/16" thickness to joints and seams. Application temperature range: 40 to 100 deg F.
  3. Service Temperature Range: -20 deg. F. to 200 deg. F.
  4. Solids Content: Minimum 62% by weight.
  5. Flexibility: Pass 1/4" (or smaller) mandrel bend test per ASTM D 522.
  6. Adhesion Strength per ASTM C794 to Bright Annealed Stainless Steel: 6.25 PLI
  7. VOC Content: Maximum 38 g/L (less water).
  8. UL 181B-M listed; UL 723 Classified.
  9. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  10. Products: Subject to compliance with requirements, provide Ductmate 'PROseal', Foster '32-19 Duct-Fas', Childers 'Chil-Flex CP-146', HardCast 'CCWI-181', or approved equal.
- D. Outdoor Duct Joint and Seam Sealant: Polymeric rubber, resins, and fiber-reinforcing materials dispersed in solvent. Applied by brush or trowel, with a 24-hour cure time. Sealant shall be UV resistant, impervious to water, and shall be permanently flexible.
1. Service Application (on this Project): Ductwork located outside the building and unconditioned outdoor air ducts located indoors.
  2. Service Temperature Range: -20 to +150 deg. F.
  3. Sealant shall be UL 181 A-M / B-M Listed and UL 723 Classified.
  4. Maximum VOC: 420 g/L.
  5. Products: Subject compliance with requirements, provide McGill Airflow LLC 'Uni-Weather', Ductmate Industries 'SOLVseal', Hardcast 'Sure-Grip 404', or approved equal.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
1. Comply with UL 723 and meet Mil-C 18969B and TTS-S-001657. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth.
  2. The use of gaskets with adhesive properties on fitting and duct connections shall not substitute for fastening hardware.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.4 HANGERS AND SUPPORTS

- A. Supports shall comply with Chapter 5 of the SMACNA Publication "HVAC Duct Construction Standards--Metal and Flexible, 4th Edition, 2021, except as modified by this Section.
- B. Building Attachments: Concrete inserts, power-actuated fasteners mechanical-expansion fasteners, or structural-steel fasteners appropriate for building materials.
1. Use power-actuated concrete fasteners for standard-weight aggregate concretes or for slabs 4 inches thick and thicker.
    - a. NOTE: Do not use power-actuated concrete fasteners for lightweight-aggregate concrete or for slabs less than 4 inches thick.
  2. Do not use strap type attachments, cable hangers, or friction type beam clips / clamps (e.g. hammer-on / slide-on flange clips and similar devices).
    - a. C-type beam clamps that incorporate a bolt for fastening, consistent with MSS Types 19 and 23, are acceptable.
- C. Hanger Materials: Galvanized, sheet steel straps or round, threaded steel rod. Strap galvanizing shall be G90, or matching that of the supported duct, whichever is greater.
1. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", 4th Edition (2021) for sheet steel width and thickness and for steel rod diameters.
  2. Do not use wire and cable hangers.
- D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
1. Fasteners for interior galvanized ducts shall be zinc or cadmium coated.
  2. Fasteners for exterior ducts not concealed by weatherproofing lagging shall be hot dipped galvanized or stainless steel.
  3. Blind rivets using pull-through mandrels are not permitted if they leave holes for air leakage. Fasteners shall not project into duct interiors more than 1/2".
- E. Trapeze and Riser Supports: Steel shapes shall comply with ASTM A 36.
1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.

2.5 RECTANGULAR DUCT FABRICATION – GENERAL REQUIREMENTS

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" (4th Edition);

2021), except as modified by this Section. Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Transverse joint types are limited to the following:
    - a. T-1 through T-14 as shown in Figure 2-1, "Rectangular Duct/Transverse Joints" in the above referenced SMACNA standard, for ductwork in the 1/2" or 1" w.g. (positive or negative) pressure classes.
    - b. Flanged duct connector systems as elsewhere specified in this Section.
    - c. Joint types explicitly specified elsewhere in this Section.
  2. Longitudinal joint types are limited to joint types shown in Figure 2-2, "Rectangular Duct/Longitudinal Seams" in the above referenced SMACNA standard, except for L-2 (button punch snap lock), which is not permitted. Joint types explicitly specified elsewhere in this Section are also permitted. Type L-3 (grooved seam) is not permitted at corner joints, but is permitted at the midpoint of sides of ductwork.
- B. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
- C. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359-inch-thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.

## 2.6 FLANGED DUCT CONNECTOR SYSTEMS

- A. A pre-fabricated flanged duct connector system is acceptable for forming transverse joints on rectangular and round ductwork where the specified pressure class can be met, and subject to other restrictions herein indicated.
- B. The system shall consist of factory-fabricated add-on flange connectors, gaskets, and related components and fasteners. Materials shall be galvanized steel to match the connecting ductwork.] The system shall be suitable for ductwork having pressure ratings from +2 inches w.g. to +10 inches w.g. and from -2 inches w.g. to -10 inches w.g. The system flanges and corner pieces shall form a flange frame around the full perimeter of the duct, and shall be designed to produce a sealed fit onto a plain duct end using an integrated sealant pocket.
1. 'Formed-on' style flanges, such as SMACNA joint types T-25a and T-25b (TDC and TDF type flanges, respectively) and similar joining methods using a flange that is formed directly from the duct end and secured in place with corner connectors, are not acceptable.
  2. Corners shall be joined using corner clips or a bolted connection.
- C. The duct connector system shall be applied in full conformance with the system manufacturer's installation instructions and with all required screws, sealants, gasket tape, corner clips, bolts, nuts, washers, and spring clip / cleats. Systems that do not use spring clips are not acceptable.
1. Substitution of zip screws for the recommended galvanized steel spring clips (cleats) is not permitted. Spring clips shall be of the length, gauge, and quantity recommended by the system manufacturer.

- D. Flange Gaskets: Permanently flexible butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
  - 1. Comply with UL 723 and meet Mil-C 18969B and TTS-S-001657. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth.

## 2.7 ROUND DUCT FABRICATION

- A. Round Ducts: Fabricate ducts with standard spiral lock seams (type RL-1), or butt weld (Type RL-4), according to Figure 3-2 of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", 2021 (4th Edition).
  - 1. Snap-lock, lapped and riveted, and grooved type longitudinal seam construction is not acceptable.
- B. Transverse Joints Between Duct Sections and to Fittings: Fabricate according to Figure 3-1, "Round Duct Transverse Joints", of the above referenced SMACNA standard.
  - 1. Ducts up to 20 Inches in Diameter: Factory fabricated slip-on gasketed flange system or type 'RT-1' beaded sleeve joint consisting of an interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
  - 2. Ducts 21 to 72 Inches in Diameter: Factory fabricated slip-on gasketed flange system or a type 'RT-2' Van Stone joint consisting of a gasketed, flanged joint with two internal flanges formed on the duct end, two exterior flanges, and flange hardware.
  - 3. Ducts Larger than 72 Inches in Diameter: Type 'RT-2A' companion angle flanged joints.
  - 4. Gasketed Push-On Joints (all sizes): Refer elsewhere in this Section for requirements for round duct joint O-ring seals:
    - a. Round Ducts: Factory-fabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
  - 5. Draw-band, crimp joint sleeve, swedge bell, and outside sleeve joints are not acceptable.

## 2.8 ROUND FITTING FABRICATION

- A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", 4th Edition (2021), with metal thicknesses specified for spiral lock seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- C. Elbows: Fabricate in die-formed (stamped), gored (segmented), or pleated construction. Single-mitered and adjustable type elbows are not permitted on round ductwork. Fabricate with a centerline bend radius of at one and one-half times elbow diameter. Fabricate elbows as follows:
  - 1. Round Elbows, 12 Inches and Smaller: Fabricate die-formed elbows for 45- and 90-degree elbows, and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
  - 2. Round Elbows, Larger than 12 Inches: Fabricate gored (segmented) elbows. Maximum 22.5 degree change in direction per segment (e.g. this requires a 5-segment elbow for a

- 90 degree change in direction, and elbows with less than 90-degree change of direction shall have proportionately fewer segments.).
3. Die-Formed Elbows for Sizes through 8 Inches and All Pressures: 0.040-inch-thick with two-piece welded construction.
  4. Round Gored (Segmented)-Elbow Metal Thickness: Same as non-elbow fittings specified above.
  5. Pleated Elbows for Sizes through 12 Inches and Pressures through 10-Inch w.g: 0.028 inch.

## PART 3 - EXECUTION

### 3.1 DUCT APPLICATIONS

- A. Refer to Division 23 Section "Common Work Results for HVAC" for definitions of 'conditioned' and 'unconditioned' spaces.
- B. Unless more restrictive requirements are scheduled on the Drawings, select and construct and seal duct systems components (ducts, fittings, and accessories) in accordance with the following SMACNA Static-Pressure and Seal Classes. The pressure ratings indicated are minimum values:
  1. Ducts Located in Interior Conditioned and Indirectly Conditioned Spaces: Unless otherwise indicated, construct ducts to the following:
    - a. Multiple Zone VAV Supply Ducts Upstream of Air Terminal Boxes and Stairwell Pressurization Ductwork Downstream of Supply Fan: +3-inch w.g., Seal Class "A".
    - b. Multiple Zone VAV Supply Ducts Downstream of Air Terminal Boxes: +2-inch w.g., Seal Class "A".
      - 1) Exception: Where exposed in the space served, Seal Class "B" may be followed.
    - c. Constant Volume Supply Ducts: +2-inch .wg., Seal Class "A".
      - 1) Exception: Where exposed in the space served, Seal Class "B" may be followed.
    - d. Return and Relief Air Ducts: -2-inch w.g., Seal Class "C".
    - e. Unconditioned Outside Air Ducts: -2-inch w.g., Seal Class "A".
    - f. Transfer Air Ducts: +1/2-inch w.g., Seal Class "C".
    - g. Exhaust Air Ducts: -2-inch w.g., Seal Class "B".
    - h. All supply and relief air ducts not explicitly addressed by the above sub-paragraphs shall be +2" w.g., Seal Class "A".
    - i. All return, outdoor air, and exhaust, ducts not explicitly addressed by the above sub-paragraphs shall be -2" w.g., Seal Class "A".
  2. Ducts Located in Interior Unconditioned Spaces: Unless otherwise indicated, construct ducts to the following:
    - a. As specified above for ducts located Interior Conditioned and Indirectly Conditioned Spaces, except that all ducts listed above to receive Seal Class "C" shall be provided with Seal Class "B" instead, and all ducts listed above to receive Seal Class "B" shall be provided with Seal Class "A" instead.

3. Ducts Located at the Exterior of the Building: Unless otherwise indicated, construct ducts to the following:

a. As specified above for ducts located Interior Conditioned and Indirectly Conditioned Spaces, except that all ducts shall receive Seal Class "A".

C. Material Application: All ducts shall be galvanized steel.

D. All ducts shall be single wall.

### 3.2 DUCT FITTING APPLICATIONS

A. Elbow Configuration: Unless explicitly noted otherwise on the Drawings, use the following elbow types:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", 4th Edition (2021), Figure 4-2, "Rectangular Elbows", as modified below. NOTE: All radii listed below are to the centerline of the duct, in the plane of change of direction.

a. Supply ducts downstream of terminal units, exhaust and return ducts upstream of terminal units, and constant volume ducts, and duct systems lacking in terminal units and air valves:

1) Radius Type RE 1 with minimum 1.5 centerline radius-to-duct width (r-to-dw) ratio.

2) Radius Type RE 1 with minimum 1.0 r-to-dw ratio.

a) These are only permitted where a 1.5 r-to-dw elbow is demonstrated to not possibly fit in the available space by way of the ductwork shop drawing and coordination drawing review and approval process.

3) Mitered Type RE 2 with small single-wall vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", 4th Edition (2021), Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

b. Supply ducts upstream of terminal units, return and exhaust ducts downstream of terminal units and air valves:

1) Radius Type RE 1 with minimum 1.5 centerline radius-to-duct width (r-to-dw) ratio.

2) Radius Type RE 3 with minimum 1.0 r-to-dw ratio and splitter vane(s) complying with Chart 4-1 and Figure 4-10 of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", 4th Edition (2021)".

a) Ducts less than 12" wide: Provide 1 splitter vane.

b) Ducts from 12" to 36" wide: Provide two (2) splitter vanes.

c) Ducts wider than 36": Provide three (3) splitter vanes.

3) Mitered Type RE 2 with small single-wall vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", 4th Edition (2021) Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

- c. All other elbow types (e.g. RE 4 un-vaned square/mitered ells, RE 5, 6, 7, 8, 9, or 10 ells, and square throat / radius heel, etc.) are not permitted, except where explicitly shown on the Drawings.
  - 1) Exception: Type RE 4 (un-vaned and mitered) ells are permitted in transfer-air ducts, and in ducts where the peak / design velocity is less than 800 feet per minute.
- 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, 4th Edition (2021), Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio:
    - 1) 1.0 centerline radius-to-diameter ratio for 90-degree elbow. These are only permitted where a 1.5 centerline radius-to-diameter elbow is demonstrated to not possibly fit in the available space by way of the ductwork shop drawing and coordination drawing review and approval process.
    - 2) 1.5 centerline radius-to-diameter ratio for 90-degree elbow.
  - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Segmented (gored) with standing seams or welded joints. Maximum 22.5 degree change in direction per segment (e.g. this requires a 5-segment elbow for a 90 degree change in direction, and elbows with less than 90-degree change of direction shall have proportionately fewer segments.)
- B. Branch Configuration: Unless explicitly noted otherwise on the Drawings, use the following branch-to-main connection types:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", 4th Edition (2021), Figure 4-6, "Branch Connection."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry, except as indicated on the Drawings.
    - b. Rectangular Main to Round Branch: Flanged or spin-in bellmouth or conical tap.
      - 1) Where the height of the duct main is insufficient to permit a bellmouth or conical tap, provide a round-to-rectangular transition on the branch duct so that a rectangular 45 degree entry connection to the main duct can be made. The transition shall be to a height equal to the main duct height, and to a width as required to maintain equal or greater total flow area as the connecting round branch duct.
      - 2) Plain, straight (e.g. constant diameter round) taps are not acceptable.
  - 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", 4th Edition (2021), Figure 3-5, "90-Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are only permitted for new branches on existing ducts.
    - a. Conical tap, 90-degree tee with oval-to-round tap, or 45-degree lateral tap. Plain taps are not permitted.
- C. Rectangular Duct Divided Flow Branches: Type 1 (dovetail), Type 2 (double vaned), and Type 4A/4B as per Figure 4-5 of the referenced SMACNA Standard.

- D. Vertical and Horizontal Offsets: Full duct dimensions shall be maintained. Use a pair of elbows complying with the above provisions. Elbows with the smallest number of degrees of change in direction that will possibly fit in the available space shall be used. Offset types shown in Figure 4-7 the referenced SMACNA Standard are not acceptable, except that Type 3 (radiused/ogee) may be acceptable where a pair of elbows is demonstrated to the Architect/Engineer to not fit in the available space.
- E. Transitions: Changes in duct sizes shall be made with uniformly sloping transitions.
  - 1. Transitions from a larger to a smaller duct in the direction of flow in either duct depth or height shall have not more than a 45 degree angle parallel to the airflow for a one sided transition, or 22.5 degree angle for a two sided transition (i.e. 22.5 degrees on each side, for 45 degrees total).
  - 2. Transitions from a smaller duct to a larger duct in the direction of flow in either duct depth or height shall have not more than a 30 degree angle parallel to the airflow for a one sided transition, or 15 degree angle for a two sided transition (i.e. 15 degrees on each side, for 45 degrees total).

### 3.3 DUCT INSTALLATION, GENERAL

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on shop drawings and coordination drawings.
- B. Construct and install each duct system for the specific duct pressure classification specified.
- C. Install round ducts in lengths not less than 12 feet, unless interrupted by fittings.
- D. All ductwork shall be constructed to be free from vibration, chatter, objectionable pulsations and leakage under final operating conditions. Provide additional external reinforcement to prevent visible or audible vibration of the duct walls.
- E. Install ducts with fewest possible joints.
- F. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- G. Provide SMACNA small type, single-wall turning vanes in all mitered duct elbows, except for transfer ducts and other clean air ducts with design velocities less than 750 feet per minute. Note that vanes may not be explicitly shown on the Drawings for clarity purposes only.
- H. Install couplings tight to duct wall surface with a minimum of projections into duct.
- I. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- J. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- K. Successfully pressure and leak test ductwork before applying external insulation.
- L. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.



- M. Where ductwork is to be lined with insulation, sizes indicated on the Drawings shall be interpreted as indicating clear dimensions inside the insulation. Adjust actual sheet metal dimensions accordingly. Shape and location of ducts may be changed to suit building conditions but cross-sectional area shall be maintained.
- N. Conceal ducts from view in finished spaces with ceilings. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- O. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- P. Duct Smoke Detectors: Duct type smoke detectors for HVAC equipment will be furnished under Division 26 or 28 and shall be installed in the ductwork under Division 23 by the HVAC system installer to conform to the requirements of the building code. For detectors that are required to affect the shutdown of an air system, the wiring from contacts on the smoke detectors or associated zone area modules to the motor controls of HVAC equipment shall be provided by the Division 23 Contractor or their ATC subcontractor to shut down the associated air handling equipment upon the detection of smoke in accordance with the requirements of the building code. Power wiring and interface wiring from the duct type smoke detectors to the building fire alarm panel will be provided under Division 26 or 28. Wiring from detectors or their associated zone area modules to affect the closure of a smoke damper or combination fire/smoke damper will be provided under Division 26 or 28.
- Q. Electrical Equipment Spaces: Route ductwork to avoid passing through electrical equipment spaces and enclosures. Ductwork not serving transformer vaults is prohibited in such spaces.
- R. Non-Fire- or Smoke-Rated Partition Penetrations: Where ducts pass through interior partitions, conceal space between construction opening and duct or duct insulation with minimum 22 gauge galvanized steel sheet flanges/frames. Overlap opening on four sides by at least 1-1/2 inches and seal to wall with silicone caulk. Seal sheet metal frame to duct with duct sealant. Tightly pack the width and depth of the annular space between wall opening and duct with ASTM C 665 rock wool batt insulation, min 2.0 lbs./cu. ft. density.
- S. Exterior Wall Penetrations: Where ducts pass through exterior walls, conceal space between construction opening and duct or duct insulation with sheet metal flanges/frames. Interior flanges shall be min. 22 gauge galvanized steel, and exterior flanges shall be min. 20 gauge stainless steel. Overlap opening on four sides by at least 1-1/2 inches and seal to wall with silicone caulk. Seal flanges to duct with duct sealant. Provide counter flashing on the top and sides of the exterior wall surface at the penetration to overlap the flanges and exterior duct waterproofing jacket min. 2". Counter-flashing shall be sealed to exterior wall construction with silicone sealant. Paint counter flashing to match the exterior color of the adjoining wall surfaces. Tightly pack the full depth and width of the annular space between wall opening and duct with ASTM C 665 rock wool batt insulation, min 2.0 lbs./cu. ft. density.
- T. Fire-Rated Wall Penetrations: Where ducts pass through interior partitions and exterior walls, install an appropriately rated fire damper. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories."
- U. Fire-Rated Slab / Floor Penetrations: Where ducts pass through discrete penetrations of fire rated slabs / floors and are not contained in a fire rated shaft enclosure, install an appropriately rated fire damper. Fire dampers are specified in Division 23 Section "Air Duct Accessories."
- V. Non-Fire-Rated Slab / Floor Penetrations: Where ducts pass through unrated floors, provide firestopping of the annular space between the duct and slab / floor opening if no rated shaft or fire damper is indicated.

- W. Fire-Rated Shaft Penetrations: Where ducts pass through a fire-rated shaft enclosure, install an appropriately rated combination fire and smoke damper. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories."
- X. Finished Ceiling Penetrations:
  - 1. Where round ducts pass through finished ceilings, provide the duct with a 1"x1" aluminum ring angles, painted to match the finished ceiling or wall, to obscure the ceiling or wall rough opening. Secure ring angles to the duct.
  - 2. Where rectangular ducts pass through finished ceilings, provide a 1"x 1" plaster frame with mitered corners for the penetration to obscure the ceiling or wall rough opening. The frame shall be aluminum and painted to match the finished ceiling or wall. The plaster frame may be constructed of ceiling system wall angles for penetrations of lay-in tile ceilings.
- Y. Painting of Ducts at Diffusers, Grilles, and Registers: Paint interiors of metal ducts that do not have duct liner for 24 inches into the duct, at each connection to a diffuser, register, or grille. Apply one finish coat of flat black fire retardant paint meeting the requirements of ASTM E84 or UL 723 for a plenum rating (flame spread index of 25 or less, and smoke developed index of 50 or less). Follow all manufacturer's recommendations and apply paint over a compatible primer. Paint shall be Flame Stop Inc. 'Flame Stop IM', Flame Control Coatings '111', or approved equal.

### 3.4 INDOOR AIR QUALITY MANAGEMENT DURING CONSTRUCTION

- A. Containment of Contaminants: The Contractor shall meet or exceed the control measures recommended by SMACNA "IAQ Guidelines for Occupied Buildings Under Construction", 2<sup>nd</sup> edition (2007) - ANSI/SMACNA 008-2008, in Chapters 3 and 4, to prevent construction dust and other contaminants from escaping the work area or contaminating new HVAC systems and equipment.
- B. Protect stored on-site and installed absorptive materials from moisture damage.
- C. The Contractor shall protect new duct and air system equipment (e.g. fans, AHUs, etc.) interiors from moisture, construction debris and dust, and other foreign materials. During ductwork system installation, keep open ends of ductwork and terminations at registers, grilles, VAV terminal units, and diffusers sealed off and closed with a polyethylene film to prevent entrance of dirt and debris. The film shall be Ductmate 'ProGuard', or approved equal. In addition, the Contractor shall take great care to thoroughly clean and wipe-down all HVAC system components and ductwork above prior and during installation.
  - 1. Comply with SMACNA "Duct Cleanliness for New Construction", 1st edition (2000), published as Appendix G of the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction", 2<sup>nd</sup> edition (2007).
    - a. Comply with the requirements of "Advanced Level" cleanliness.

### 3.5 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure classes and seal classes specified and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", 4th Edition (2021), unless more restrictive requirements are indicated in this Section.
- B. Seal and successfully pressure test externally insulated ducts before insulation installation.

- C. Seal duct seams and joints according to the referenced SMACNA standard, or this Section, whichever is most restrictive / demanding:
1. For ducts where Seal Class A is indicated, seal transverse joints, longitudinal seams and wall penetrations (except for damper rod penetrations).
  2. For ducts where Seal Class B is indicated, seal transverse joints and longitudinal seams.
  3. For ducts where Seal Class C is indicated, seal transverse joints only.
  4. Regardless of the Seal Class specified, any joint, seam, or wall penetration through which air leakage makes an audible noise at a distance of 4 feet shall be sealed till the leakage is no longer audible.

### 3.6 HANGING AND SUPPORTING

- A. Unless otherwise indicated or specified, install rigid round and rectangular metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", 4th Edition (2021).
1. Supporting ductwork and associated equipment from metal roof and floor decking is prohibited. All ductwork and associated equipment shall be supported from the building structural system.
  2. Ductwork shall be supported directly from the building's steel beams or from miscellaneous structural steel provided by the Division 23 Contractor bearing on steel beams.
  3. Loads supported by steel bar joists exceeding 100 lbs. shall be located at the joist panel points, and shall not impose an eccentric load (twisting moment). Provide supplemental steel and align direct hanger connections to the joists with the joist centerline. Connect to the upper chord of the joist wherever it is possible to do so.
  4. Do not drill or cut building structural steel.
- B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts with steel or aluminum angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet. Angles bearing on floors shall overlap the floor opening by no less than 3".
- D. Refer to Division 23 Section "Vibration Controls for HVAC" for ductwork systems requiring vibration isolation hangers and supports. Vibration isolated ductwork shall be installed such that it does not contact building structure, walls, or other building elements or work that fixed in place.
- E. Hanging ductwork from roof and floor decking in steel framed buildings is prohibited. All equipment shall be hung from building steel structural system (e.g. steel beams and joists).
1. Ductwork shall be supported directly from the building's steel beams or from miscellaneous structural steel provided by the Division 23 Contractor bearing on steel beams.
  2. Loads supported by steel bar joists exceeding 100 lbs. shall be located at the joist panel points, and shall not impose an eccentric load (twisting moment). Provide supplemental steel and align direct hanger connections to the joists with the joist centerline. Connect to the upper chord of the joist wherever it is possible to do so.
  3. Supplemental steel deflections shall be limited to length/180 of the span.

F. Fastener System Installation in Concrete Slab Construction:

1. Install power-actuated fasteners for use in lightweight concrete or concrete slabs at least 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by power-actuated tool manufacturer. Install fasteners according to power-actuated tool manufacturer's operating manual.
2. Install drilled-in mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
3. Anchor capacity used in design shall be based on the technical data published by the manufacturer or such other method as approved by the Architect and Structural Engineer of Record.
4. Anchor capacity is dependent upon spacing between adjacent anchors and proximity of anchors to edge of concrete. Install anchors in accordance with the manufacturer's recommended spacing and edge clearances.
5. Reinforcing bars in the concrete structure may conflict with specific anchor locations. Exercise care to avoid damaging existing reinforcing or embedded items. The Contractor shall review the structural drawings and shall undertake to locate the position of the reinforcing bars near the locations of the concrete anchors, by Hilti 'Ferrosan, GPR', X-rays, or other non-invasive means approved by the Architect and Structural Engineer of Record. Notify the Architect and Structural Engineer of Record if reinforcing steel or other embedded items are encountered during drilling.
6. Install concrete inserts before placing/pouring concrete.

3.7 CONNECTIONS

- A. Connect equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."
- B. For outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", 4th Edition (2021), unless detailed otherwise on the Drawings.
- C. Make ductwork connections to curb-mounted rooftop equipment by extending ductwork to the top of the roof curb. Provide a duct transition as required to terminate the duct at the top of the curb with a size matching that of the mating duct connection opening on the curb and on the equipment. Provide neoprene gasket on the mating surfaces between the duct end or curb and the equipment.

3.8 PRESSURE AND LEAKAGE TESTS

- A. Disassemble, reassemble, and seal segments of systems as required to accommodate pressure and leakage testing and as required for compliance with test requirements.
- B. Conduct tests, in presence of the Architect / Engineer, at static pressures equal to maximum design pressure of system or section being tested. Do not pressurize systems above maximum design operating pressure. Give a minimum of seven (7) days' advance notice for testing. Test for leaks before applying external insulation. Where less than 100% of duct systems are specified below to be pressure tested, the Architect / Engineer reserves the right to select the particular portions of the duct systems to be tested. Pressure-test the following:

1. Indoor Ducts:
    - a. No less than 33% of the total duct wall area of indoor ductwork with a pressure rating +2" w.g. or higher shall be pressure tested. This percentage requirement applies individually to each separate duct system associated with a given air handling unit, fan, etc.
      - 1) Exception: 100% of all ductwork located in mechanical rooms, shafts, chases, tunnels, crawlspaces, or attics shall be pressure tested, regardless of pressure class.
    - b. No less than 33% of the total duct wall area of indoor ductwork with a pressure rating of -2" w.g. or lower (i.e. more negative; e.g. -4" w.g.) shall be pressure tested. This percentage requirement applies individually to each individual duct system associated with a given air handling unit, fan, etc.
      - 1) Exception: 100% of all ductwork located in mechanical rooms, shafts, chases, tunnels, crawlspaces, or attics shall be pressure tested, regardless of pressure class.
    - c. Indoor ductwork with a pressure rating between -1" w.g. and +1" w.g. does not require pressure testing.
  2. Outdoor Ducts: 100% of all ducts located outdoors shall be pressure tested, except for unconditioned outdoor air intake ducts that are under negative pressure.
- C. Determine leakage from entire system or section of system by relating leakage to surface area of test section.
- D. Inspect the pressurized ductwork for distortion or other physical damage that resulted from pressurizing the ductwork to the test level, and for audible leakage points. Repair and reinforce areas where physical damage occurred and seal all audible leaks, then perform a retest.
- E. Maximum Allowable Leakage:
1. Round Ducts: Comply with requirements for Leakage Classification 4 for indoor ducts in pressure classification of 2-inch w.g. and lower, and Leakage Classification 2 for all outdoor ducts, and indoor ducts in pressure classification 3-inch w.g. and higher.
  2. Rectangular Ducts: Comply with Leakage Classification 8 for indoor ducts in pressure classification of 2-inch w.g. and lower, and Leakage Classification 4 for all outdoor ducts and indoor ducts in pressure classifications from 3-inch w.g. and higher.
  3. If a given duct test section fails, the Contractor shall:
    - a. Remake leaking joints and retest until leakage is less than maximum allowable for that test section.
    - b. Pressure-test an additional, previously untested section of ductwork that is of equal or greater surface area as the section that failed the initial pressure test. The Architect / Engineer shall select the additional duct test section(s).
- F. Leakage Test Method: Perform tests and report results according to Chapters 4 through 7 of the 2nd Edition (2012) of SMACNA's "HVAC Air Duct Leakage Test Manual" except where these specifications exceed or modify SMACNA requirements.

### 3.9 INSTALLATION OF INTERIOR, EXPOSED DUCTWORK IN FINISHED SPACES

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Use duct joining methods that do not rely on the use of brush-on external sealants. Utilize flanged duct connector systems, bell-spigot O-ring joint systems on round ductwork, and welded joints. On flanged duct connection systems, trim duct flange gaskets and sealants that protrude flush with the metal to create a smooth and uniform exposed bead.
- C. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets. Coordinate duct elevations and locations with the lighting and sprinkler layouts so that ductwork does not block lighting or interfere with sprinkler coverage per NFPA 13 requirements.
- D. Remove all visible shop writing, labels, etc.
- E. Hangers for round ducts shall be teardrop style strap hangers using a single threaded rod.
- F. Repair or replace damaged sections and finished work that does not comply with these requirements.
- G. Provide the ductwork and hangers and supports with a paint finish as specified in Division 09. Paint exposed ductwork colors as selected by the Architect.

### 3.10 ADJUSTING

- A. Adjust volume-control dampers in ducts, outlets, and inlets to achieve design airflow.
- B. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for detailed procedures.

END OF SECTION 233113

## SECTION 233300

### AIR DUCT ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 ADDITIONAL RELATED DOCUMENTS

- A. Related Sections:
  - 1. Division 26 or 28 for duct-mounted smoke detectors.
  - 2. Division 23 Section "Diffusers, Registers, and Grilles" for manual volume dampers that are integral to diffusers, registers, and grilles.

##### 1.3 SUMMARY

- A. This Section includes the following:
  - 1. Backdraft dampers
  - 2. Manual-balancing volume control dampers
  - 3. Life-safety dampers
  - 4. Single wall turning vanes and vane rails
  - 5. General duty duct-mounted access doors
  - 6. Instrument test holes
  - 7. Flexible ducts
  - 8. Flexible connectors
  - 9. Duct accessory hardware
  - 10. Remote balancing damper operators

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
  - 1. Special fittings and manual-volume-damper installations.
  - 2. Fire-, smoke-, combination fire/smoke, and ceiling radiation damper installations, including sleeves and duct-mounted access doors and panels.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved. Also include locations of remote balancing damper operators and instrument test holes for use by the Testing and Balancing Agent.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

## 1.7 QUALITY CONTROL

- A. NFPA Compliance: Comply with the following NFPA standards:
  - 1. NFPA 80 and NFPA 105 for testing and inspection of fire dampers, smoke dampers and combination fire/smoke dampers.
- B. Combustion Ratings. All duct accessory materials shall be equal to or less than the combustion ratings noted below when tested in accordance with ASTM E84, UL723 and NFPA 255.
  - 1. Flame Spread Classification: < 25
  - 2. Smoke Development Rating: < 50
- C. All duct accessories shall meet or exceed the SMACNA pressure class standards for the ductwork system in which they are installed, or the specified ratings, whichever are higher.
- D. Damper pressure drop and air leakage ratings shall be based on tests and procedures performed in accordance with AMCA 500-D.

## 1.8 COORDINATION

- A. Coordinate with the General Contractor the selection and installation of life safety dampers with the architectural assemblies in which they are installed, so that the damper maintains the fire and smoke resistance of the assembly per the UL listing, and the damper can be installed in full accordance with its own UL listing.

## 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
  - 1. Fire Damper Fusible Links: Furnish quantity equal to 5 percent of each type and size installed, or one (1) of each type and size installed, whichever is larger. Provide documentation that clearly explains where each replacement fusible link may be used.
  - 2. Smoke and Combination Fire-Smoke Damper Motors: Furnish quantity equal to 10 percent of each type and size installed, or one (1) of each type and size installed, whichever is larger. Provide documentation that clearly explains where each replacement damper motor may be used.



3. Combination Fire-Smoke Damper Firestats: Furnish quantity equal to 5 percent of each type and size installed, or one (1) of each type and size installed, whichever is larger. Provide documentation that clearly explains where each replacement firestat may be used.

## PART 2 - PRODUCTS

### 2.1 BACKDRAFT AND MANUAL BALANCING DAMPERS

- A. General: The following general provisions apply to all dampers, unless noted otherwise:
  1. Dampers shall be rated for no less than 2,000 feet per minute (fpm).
  2. Dampers shall be pressure rated for no less than the system pressure to which they are connected, or the specified rating herein, whichever is higher.
  3. Nominal damper dimensions shall match the connecting ductwork size indicated.
  4. Contractor shop-fabricated dampers are not acceptable. Dampers shall be factory fabricated by one of the manufacturers listed herein.
  5. Dampers shall have flanged or slip end connections. 'In-duct' type installations are not acceptable.
- B. Backdraft Dampers:
  1. Standard-Construction Backdraft / Barometric Relief Dampers: Factory made of minimum .050" extruded 6063-T5 aluminum blades supported on aluminum, stainless steel, or zinc plated steel rods (axles), in nylon or Celcon® bearings, set in minimum .060" 6065-T5 extruded aluminum frame. Blades shall be fitted with mechanically fastened extruded silicone or vinyl seals on contact edges to prevent noise. Aluminum and zinc-plated steel linkage hardware shall installed in the side of the frame. Damper assembly shall be provided with an adjustable counter-balance device adjusted to assist closing or opening as indicated or required by the application. Counterweight shall permit the start of opening with as little as 0.01" w.g. differential pressure.
    - a. Fans and gravity ventilators equipped with backdraft dampers shall be furnished with dampers conforming to the requirements of this specification, and shall be furnished with dampers no smaller than the full size of the connecting collar.
    - b. Dampers shall be suitable for up to 3" w.g. system pressure and 2,000 fpm velocity. Provide multiple dampers mulled together to form backdraft dampers with blade widths accommodating these pressure and velocity rating requirements.
    - c. Static pressure drop at 1,500 fpm face velocity shall not exceed 0.25" w.g. when tested in accordance with AMCA 500D in the 24"x24" size.
    - d. Dampers shall not have a leakage rate exceeding 10 cfm/sq.ft. at 1.0" w.g. differential pressure when tested in accordance with AMCA 500D in the 24"x24" size.
    - e. Damper shall be TAMCO Series '7000CW / 7000WT', or approved equal.
- C. Standard-Construction Rectangular (Manual Balancing) Volume Control Dampers:
  1. Volume control dampers shall be of the factory fabricated opposed blade, multi-blade type, controlled from a single point using linkages and a manual, locking quadrant.. On insulated ducts, the quadrant shall have a minimum 2" standoff bracket (or as otherwise required to accommodate the specified insulation thickness and permit damper operation without insulation damage). Dampers shall be mounted in minimum 16 gauge roll formed galvanized steel channel frames with corner reinforcements. Blades shall be minimum 18 gauge galvanized roll-formed steel with a triple-V profile. Damper axles shall be 1/2"

diameter plated steel, square or hex type, and the bearings shall be bronze or stainless steel oilite. Adjusting devices shall have locking mechanisms and shall be accessible. Damper shall be suitable for up to 2,000 fpm and 3.0" w.g. system pressure. Quadrants shall be oriented so that when the handle is parallel to the direction of airflow, the damper shall be fully open.

- a. At the Contractor's option, for rectangular dampers no taller than 12" on systems specified with a pressure rating of 2" w.g. or less, and exposed to velocity no greater than 2,000 fpm, a single blade type damper complying with all other provisions indicated above may be provided, however the bearings (including the end bearing) are permitted to be synthetic, and the frame and blades may be as thin as 18 and 20 gauge, respectively.

D. Standard-Construction Round (Manual Balancing) Volume Control Dampers:

1. Factory fabricated, single blade, center pivoted, constructed of galvanized sheet steel, minimum 22 gauge blade and frame for diameters up to 12", and minimum 20 gauge blade and frame for diameters larger than 12". Damper shall be controlled from a single point with a manual locking quadrant, and the opposite end shall be fitted with an end bearing support (i.e. no cantilevered dampers). On insulated ducts, the quadrant shall have a minimum 2" standoff bracket (or as otherwise required to accommodate the specified insulation thickness and permit damper operation without insulation damage). Axle shall be 1/4" square or hex shaped, plated steel, and the bearings shall be synthetic or brass. Damper shall be suitable for up to 2,000 fpm and 2.0" w.g. system pressure. Quadrants shall be oriented so that when the handle is parallel to the direction of airflow, the damper shall be fully open.

- a. For systems with a specified pressure class above 2" w.g. and up to 3" w.g., the Contractor shall provide one of the following:
  - 1) Provide a square, multi-blade damper as specified above with a pair of square to round transitions. The height and width of the square damper shall match the round duct diameter indicated.
  - 2) Provide a round damper with a pressure rating meeting or exceeding the specified pressure class of the connected duct system.

E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Backdraft Dampers:

- a. Air Balance Inc.
- b. American Warming & Ventilating (AWV)
- c. Arrow United Industries, Inc.
- d. Greenheck Fan Corp.
- e. Ruskin Company
- f. Pottorff
- g. Cesco Products, Div. of Mestek Inc.
- h. TAMCO, T.A. Morrison and Co. Inc.
- i. Or equal as approved by the Professional.

2. Manual Balancing Volume Control Dampers:

- a. Air Balance Inc.
- b. American Warming & Ventilating (AWV)

- c. Louvers and Dampers, Inc.
- d. NCA Manufacturing.
- e. United McGill Corp.
- f. Ruskin Company
- g. Pottorff
- h. Cesco Products, Div. of Mestek Inc.
- i. TAMCO, T.A. Morrison and Co. Inc.
- j. Or equal as approved by the Professional.

## 2.2 LIFE SAFETY DAMPERS

### A. Fire Dampers:

1. **General:** Provide dynamically rated fire dampers with fusible links, where required by the 2018 International Building Code, and where indicated on the Drawings. Fire dampers shall be rated for 1-1/2 hours or 3 hours as required by the fire rating of construction in which they are installed. Fire dampers shall be UL 555 listed by a Nationally Recognized Testing Laboratory, and approved for each particular type of installation in accordance with UL, and the 2018 International Building Code. Provide dampers in accordance with UL requirements for the particular combinations on the project, and provide associated sheet metal construction in accordance with SMACNA guidelines. Fire dampers shall be accessible, with suitable means provided for replacing fusible links. Access doors shall be provided in ductwork, walls and ceilings. Provide dampers for grille access or 'out of wall' installation where indicated or required by the project conditions. Multiple dampers shall be joined together with mullions to form a damper of the required size where required and permitted by the UL listing, however dampers where both nominal dimensions are 36" or less shall be a single damper (no mulling of multiple dampers permitted).
2. **Construction:** Dampers shall be of the curtain type unless the multi-airfoil bladed type is required for the indicated size, or specified pressure or velocity ratings. Multi-bladed dampers, if provided, shall incorporate an external crank lever. Damper blades and frames shall be fabricated of galvanized steel. Frames shall be one piece. Closure springs shall be stainless steel.
3. **Fusible Link Temperature Rating:** Fusible links shall have temperature rating of 165 degrees F. unless specifically indicated otherwise.
4. **Pressure and Velocity Ratings:** Fire dampers dynamically rated for a duct velocity of 2000 FPM (minimum), and pressure levels of 4-inch w.g. (minimum), or to match duct system static pressures and velocities in which they are installed, whichever is greater. Fire dampers shall be suitable for installation in horizontal and vertical positions, as indicated on the Drawings.
5. **Installation Accessories:** Each fire damper shall include a sleeve and mounting angle set furnished by the damper manufacturer to ensure a UL listed installation.
6. **Damper Style:** Dampers shall be Type C, CR, or CO with duct transitions to match the connecting duct shape, in order to place both the damper blades and the damper frames completely out of the airstream.
  - a. **Exception:** Type B is acceptable where the connecting duct flow area is 4.0 sq. ft. or greater, unless indicated otherwise on the Drawings.
  - b. **Exception:** Type A is acceptable where a grille is installed in a fire-rated wall.
7. **Sizing:** Fire dampers shall have a nominal size / connection size matching the duct in which it is installed.

B. Smoke Dampers:

1. General: Provide dynamically rated smoke dampers at locations shown on the Drawings and as required to meet requirements of the 2018 International Building Code. Dampers shall be factory furnished with damper operators and the entire assembly shall be UL555S listed. Smoke dampers shall be constructed and installed in accordance with applicable requirements of the UL listing and the 2018 International Building Code. Provide dampers for grille access or 'out of wall' installation where indicated or required by the project conditions. Multiple dampers shall be mulled together where required.
2. Construction: Smoke dampers shall be parallel blade type dampers suitable for high velocity service and shall be constructed for low leakage and low pressure drop. Smoke dampers shall be furnished with a UL 555S label and NFPA 90A classified label. Damper assembly including operator shall be qualified under UL for an elevated temperature rating of 350 degrees F. The damper's UL 555S Classified leakage shall not exceed 8 CFM per sq. ft. at 4 inches w.g. (UL555S Leakage Class I). Damper frames shall be constructed of minimum 16 gauge Type 304 or 316 stainless steel and the blades shall be airfoil type constructed of double skins of minimum 16 gauge galvanized steel or triple-V type constructed of minimum 16 gauge Type 304 or 316 stainless steel. Damper blades shall not exceed 7 inches in width. The damper shall be UL qualified for 3,000 fpm velocity and a duct pressure of 4" w.g. Damper bearings shall be self-lubricating bronze sleeve type. Replaceable silicone rubber seals shall be installed along each blade edge in integral ribbed groove inserts in frames and blades. Compression type stainless steel seals shall be provided on top, bottom and sides of frame.
  - a. Smoke Dampers Associated with Stair Pressurization Systems: For remote position monitoring by the building fire alarm system or building ATC system, each smoke damper shall also be furnished with a pair of single pole, single throw end switches (with open/closed indicator) for remote position monitoring of damper blades at each terminal position (i.e. fully open and fully closed).
3. Damper Style: Dampers shall be Type C, CR, or CO to match duct shape, or equivalent, in order to place the damper frames completely out of the airstream.
4. Sizing: Smoke dampers shall have a nominal size / connection size matching the duct in which it is installed.
  - a. Exception: All rectangular ducts which are less than 16" in height, shall be provided with smoke dampers that are oversized by 2" in height. Provide duct transitions to match connecting duct size. Openings in smoke separations shall be oversized accordingly to accommodate the larger damper. Where it has been shown to be impossible to oversize the duct/opening, then a flat top and bottom frame style shall be used.

C. Combination Fire/Smoke Dampers:

1. General: Provide dynamically rated combination fire/smoke dampers at locations shown on the Drawings and as required to meet requirements of the 2018 International Building Code. Dampers shall be factory furnished with damper operators and the entire assembly shall be both UL555 and UL555S listed. Combination fire/smoke dampers shall be constructed and installed in accordance with applicable requirements of the UL listing and the 2018 International Building Code. Provide dampers for grille access or 'out of wall' installation where indicated or required by the project conditions. Multiple dampers shall be mulled together where required.
2. Combination fire/smoke damper assemblies shall be furnished with a UL 555S label and NFPA 90A classified label. Dampers shall utilize a parallel multi-blade type construction and bear either a 1-1/2 hour or 3-hour UL label, as required by the fire rating of construction in which they are installed.

3. Damper shall bear a UL 555S leakage classification rating of 8 CFM per sq. ft. at 4 inches w.g. (UL 555S Class I). Damper frames shall be constructed of minimum 16 gauge galvanized sheet steel. Blade construction shall be minimum 16 gauge galvanized steel, double skin airfoil blade design. Damper shall be UL qualified for a velocity of 3,000 feet per minute and 4 inches water gauge duct pressure. Blades shall be center pivoted so they can be installed for air flow in either direction. Dampers shall be qualified under UL for an elevated temperature rating of 350 deg. F. Damper bearings shall be self-lubricating bronze sleeve type. Replaceable silicone rubber seals shall be installed along each blade edge in integral ribbed groove inserts in frames and blades. Compression type stainless steel seals shall be provided on top, bottom and sides of frame.
4. Each fire/smoke damper shall be equipped with a UL classified firestat or electro-mechanical link resettable with remote or local command operation. Fusible links are not an acceptable means of heat detection. The damper shall automatically close upon detection of temperatures above 165 deg. F., or upon the detection of smoke in the ductwork.
5. Damper Style: Dampers shall be Type C, CR, or CO to match duct shape, or equivalent, in order to place the damper frames completely out of the airstream.
6. Installation Accessories: Each combination fire/smoke damper shall include a sleeve and mounting angle set furnished by the damper manufacturer to ensure a UL listed installation.
7. Sizing: Combination fire-smoke dampers shall have a nominal size / connecting size matching the duct in which it is installed.
  - a. Exception: All rectangular ducts which are less than 16" in height, shall be provided with combination fire-smoke dampers that are oversized by 2" in height. Provide duct transitions to match connecting duct size. Openings in shafts and fire/smoke separations shall be oversized accordingly to accommodate the larger damper. Where it has been shown to be impossible to oversize the duct/opening, then a flat top and bottom frame style shall be used.
8. Actuators:
  - a. General: Actuators for combination fire/smoke dampers shall be factory furnished complete with linkages, extended shaft and damper actuators externally mounted (i.e. out of the airstream). Dampers shall be of the direct mount type. Only where direct coupling is impossible due to space constraints or geometry of damper installation shall linkages be employed. Linkages shall be designed specifically for the actuator. Actuators shall be UL 873 or UL 60730 listed.
    - 1) Internal mounted actuators shall be utilized in the following cases. Such cases shall be demonstrated by the Contractor to the satisfaction of the Professional prior to utilizing an internally mounted actuator. Each internally mounted actuator proposed by the Contractor requires pre-approval by the Professional:
      - a) Where insufficient space exists to install and service an externally mounted actuators.
      - b) Where the penetration is of rated exterior wall or slab and installation and service access to the actuator from the inside of the building has been demonstrated to be impractical, and no NEMA 3R or 4x actuators are available.
  - b. Construction: Actuators shall be electric (120 volt) with gear trim submerged in oil and sealed in steel or plastic case. Actuators shall be tested under UL 555S at 20,000 cycles. Actuators and the associated damper shall be suitable for elevated temperature service and shall be UL 555 and 555S listed at an elevated temperature rating of 350 degrees F. Actuators shall be suitable for continuous exposure of up

to 120 deg. F. Actuator shall drive open in 15 seconds or less, and spring close in 15 seconds or less at elevated temperature. Actuators shall be UL 2043 listed for low smoke generation in ducts and plenums. Actuators shall have electronic or microcontroller-based motor control providing electronic cut off at full open so that no noise is generated while holding open, and shall have overload protection so that the actuators are incapable of burning out if stalled before reaching full rotation. The noise level of the actuator when holding the open position shall be inaudible. The actuators shall be directly coupled and employ a steel toothed cold-weld V-bolt clamp for connecting to damper shafts. Aluminum clamps or set-screw attachment are not permitted.

- c. Control: Two position, spring return closed.
- d. Manufacturer's Warranty: 5 years.

D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Ruskin Company (Basis of Design)
- 2. Greenheck, Inc.
- 3. Pottorff
- 4. Cesco Products, a Div. of Mestek Inc.
- 5. NCA; a Div. of Metal Industries Inc.
- 6. Or equal as approved by the Professional.

## 2.3 FLEXIBLE DUCTS

A. General: Use of flexible air ducts shall be permitted for connecting air diffusers to metal ducts. Flexible duct individual lengths shall not exceed 6 feet, or as indicated on the Drawings, whichever is less. Ducts shall be suspended with band hangers to prevent sagging and kinking, and as required by the Air Diffusion Council (ADC) Publication "Flexible Duct Performance And Installation Standards", 5th Edition. Flexible ducts shall be listed by Underwriters' Laboratories under UL 181 as a Class I flexible air duct material and shall comply with NFPA Standard 90A.

B. Construction: Flexible ducts shall be a factory fabricated assembly consisting of a polymeric or two-ply polyester liner duct (core) bonded permanently to a coated spring steel wire helix supporting a fiberglass insulating blanket and covered with a fiberglass scrim-reinforced metalized film vapor barrier laminate. The outer vapor barrier shall have a permeance rating no greater than 0.05 perms per ASTM E96, Method A. Insulation value shall be no less than R-6. Ducts shall be suitable for no less than 140 deg. F. continuous operating temperature, 5,000 FPM air velocity, and +6" w.g. static pressure in all sizes up to 16" flow area diameter. All materials shall be fire and smoke rated for installation within a return air plenum.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Thermaflex (Type 'M-KE' or 'M-KC').
- 2. Flexmaster USA, Inc. (Type '6M').
- 3. JP Lamborn Co. (JPL) (Type 'MHP-50')
- 4. Atco Rubber Products Inc. (Types '036' or '039')
- 5. Or equal as approved by the Professional.

## 2.4 SINGLE WALL TURNING VANES AND VANE RAILS

- A. Turning vanes shall be installed at each mitered elbow of all square or rectangular ductwork, and shall be of sizes to suit ductwork. Vanes shall be set in factory-fabricated vane rails. Turning vanes and vane rails shall be aluminum, stainless steel, or galvanized steel, and shall match the ductwork material in which they are installed.
- B. Turning vanes shall be of the single wall (single-thickness) type, with hemmed ends on the upstream side, and lacking extended trailing ends. Turning vanes shall be factory- or shop-fabricated in accordance with Figure 4-3 and Figure 4-4 of the SMACNA "HVAC Duct Construction Standards, Metal and Flexible", 3rd edition (2005). Vane material shall be no less than 0.029-inch thick (22 gauge), and shall be suitable for no less than 2,500 feet per minute air velocity. Use SMACNA "Small" vanes (2" radius at 1.5" spacing) for all duct widths. For vanes longer than 36", install in multiple sections with the runners fastened together, or provide a tie rod secured to the vanes at mid-span.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. C.L. Ward LLC
  - 4. Sheet Metal Connectors Inc.
  - 5. Or equal as approved by the Professional.

## 2.5 DUCT ACCESS DOORS

- A. General Duty Duct Access Doors: Furnish and install access doors and frames to permit inspection, operation and maintenance of devices concealed behind the sheet metal work. Provide duct access doors of insulated double wall construction, not less than 24 gauge, galvanized steel. Provide doors and frames constructed of aluminum or stainless steel, in lieu of galvanized steel, where required to match the ductwork. Insulation shall be 1-1/2 PCF fiberglass, no less than 1" thick. Where ducts are uninsulated, insulation in access doors may be omitted.
  - 1. Light Duty Doors: Systems specified for 2" w.g. and SMACNA Seal Class B or C, or lower, shall utilize a double-cam or piano hinge-and-cam, square-framed access door. Doors may be either factory-fabricated or shop-fabricated. Doors shall be fitted with foam rubber gaskets around their entire perimeter, at both the door to frame junction, and where the frame meets the duct wall. Frames shall be secured to the duct using bend-back tabs and sheet metal screws.
    - a. Construct doors in accordance with Figure 7-2 of the SMACNA "HVAC Duct Construction Standards, Metal & Flexible" Third Edition (2005).
    - b. Sizing: Provide duct access doors no smaller than 18" x 18". Provide ducts smaller than 20" in height with access doors two (2) inches less in height than the height of the duct. In such cases, the length of the door shall be 18".
    - c. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Arrow United Industries
      - 2) Ductmate Industries
      - 3) Duro Dyne Inc.
      - 4) Flexmaster USA
      - 5) Pottorff

- 6) Ruskin
- 7) Ward Industries; a Div. of Hart and Cooley Inc.
- 8) Or equal as approved by the Professional.

2. High Pressure / Low Leakage Doors: Systems specified for 3" w.g. and higher, and all systems specified for SMACNA Seal Class A, shall utilize either round, spin-in type or flat-oval or rectangular compression (i.e. sandwich) type access doors.

a. Construction:

- 1) Round Spin-In Doors: 22 ga. galvanized steel spin-in type frame and 24 ga. galvanized steel door. Door shall be double wall with 1" of insulation and a minimum insulating value of R-3. Door shall be secured with no less than three (3) latches, and shall have a full perimeter neoprene gasket. The door shall be suitable for duct pressures as high as 10" w.g., positive or negative.
- 2) Compression Doors: Door shall be of the sandwich type that compresses the duct wall between panels constructed of stamped galvanized steel. Panels shall be curved or flat, as required to suit the duct shape and assure minimal leakage. One panel shall be fitted with a full perimeter gasket, and the second shall be either double wall with internal insulation or fully lined with insulation, minimum 1/4" thick. The door shall be secured with no less than two bolts with springs and hand knobs. The door shall be suitable for duct pressures as high as 10" w.g., positive or negative.

b. Sizing and Quantity:

- 1) Round door diameters and square door heights shall be equal to the duct height minus two (2) inches. Where duct heights are less than 14", provide a compression door instead.
- 2) Compression Doors: Sized nominally at 16"x12". Where duct heights are less than 14", provide two (2) 10"x6" doors.

c. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Round, Spin-In Doors: Flexmaster USA ('SDSM' series) or Ward Industries ('DSP' series).
- 2) Compression Doors: Ruskin ('ADR/ADF' series), Ductmate Industries ('Sandwich' series), or Ward Industries ('DSA' series).
- 3) Or equal as approved by the Professional.

## 2.6 ACCESSORY HARDWARE

A. Fasteners and other hardware used to fasten duct accessories that penetrate duct walls shall utilize gasket-backed sealing washers.

B. Instrument Test Holes: Cast iron, cast zinc alloy, cast bronze, or cast aluminum to suit duct material, including cap, base flange with screw holes and adhesive-backed gasket. Size (diameter) to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness. The cap shall screw-on, or shall use an expansion mechanism. Coordinate quantities and locations with the Testing, Adjusting and Balancing Agent.

1. Screw fasteners shall be galvanized on galvanized steel ducts.



## 2.7 FLEXIBLE CONNECTORS

- A. General: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84 or UL723. Connectors shall be suitable for a pressure range of no less than +10 w.g. to -10 w.g.
- B. Metal-Edged Connectors: Factory fabricated with a strip of minimum 3 inches wide fabric attached using a double fold offset seam to two (2) strips of minimum 3-inch-wide, min. 24 gauge G-90 galvanized sheet steel, or min. 22 gauge series 3003 aluminum sheet. Provide metal matching the connecting duct.
  - 1. Connectors used on round connections to fans shall have a reinforcing rib on the centerline of the fabric.
- C. Spring Links: Two brackets connected by a steel spring, and applied to prevent connector from being fully elongated or collapsed during use.
- D. Indoor System, Flexible Connector Fabric: Woven fiberglass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd..
  - 2. Minimum Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.
- E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. C.L Ward LLC
  - 4. Hardcast; a Div. of Carlisle Co.
  - 5. Or equal as approved by the Professional.

## 2.8 CABLE-TYPE REMOTE BALANCING DAMPER OPERATORS

- A. Description: 'Bowden'-type cable system designed for remote manual (i.e. non-motorized, non-automatic) balancing damper adjustment. The actuator mechanism and guide tubing (e.g. casing or sheath) shall be constructed of stainless steel, galvanized steel, brass, or aluminum, and the cable shall be stainless steel. The controller shall consist of a self-locking worm gear assembly. The regulator connected to the damper shaft shall consist of a shaft connector hub, wire stop, angle bracket, and casing coupling. The tubing and cable shall be up to 40 feet long, if required. The cable and housing shall be routed entirely outside of the airstream and compatible with manual balancing dampers specified elsewhere in this Section. Dampers furnished as a package with the remote operator are acceptable if they meet the balancing damper specifications found elsewhere in this Section. Radial-type dampers furnished with the remote operator and the routing of actuator housing and cables inside the duct airstream are not acceptable.
  - 1. Unless indicated otherwise on the Drawings, locate the operator above the nearest accessible lay-in tile ceiling. Provide a mounting bracket and secure to the building structure, or to a wall or wall stud. Provide labeling that indicates which specific diffuser, grille, etc. is associated with the operator. Labeling shall reflect the final room numbers being used by the Client Agency.

2. Where no accessible ceiling is located within 40 feet of the damper, provide a recessed, round wall or ceiling mounting cup for the operator. The cup shall be steel or aluminum and shall have a round stainless steel cover plate no larger than 3" in diameter. In this installation, the regulator connected to the damper shaft shall consist of a self-locking worm gear assembly.
  3. Where indicated or detailed as such on the Drawings, locate the operator inside the plenum of slot diffusers with an L-shaped bracket, with access through the opening in the slot diffuser. When locating the operator, the final adjustment position of the slot diffuser pattern controller shall be considered, so that the pattern controller does not need to be moved to make adjustments to the damper.
  4. Furnish one (1) cable adjustment tool to the Client Agency, if the tool is proprietary.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Metropolitan Air Technology (MAT)
  2. Pottorff
  3. United Enertech
  4. Young Regulator Company
  5. Or equal as approved by the Professional.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to manufacturer's instructions and applicable details shown in SMACNA's "HVAC Duct Construction Standards, Metal and Flexible", 3rd Edition (2005), except as elsewhere modified by the project Specifications or Drawings.
- B. Install duct accessories of materials suited to duct materials. Unless otherwise noted, use galvanized-steel or aluminum accessories in galvanized-steel ducts.
- C. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
- D. Dampers shall be selected so their static pressure ratings are no less than that specified for the connecting ductwork, and the damper velocity rating is no less than the design velocity of the duct section in which each damper is installed.
- E. Handle dampers using the frame or sleeve. Do not lift or move damper using blades or actuator.
- F. Install remote balancing damper operators to provide for remote balancing damper adjustment where the dampers are not easily accessible through a lay-in tile ceiling. For the mechanical cable type, support cable sleeve as necessary to prevent twisting or sharp bends. Do not cover the damper operating assembly with any type of duct insulation. Test each operator through the complete range of adjustment prior three (3) times to concealment.
  1. Coordinate the locations of operators / adjustment stations with the Professional during shop drawing generation, and depict the locations on the ductwork shop drawings and/or coordination drawings. Verify operator locations with Professional prior to installation.
- G. Instrument Test Holes: Provide test holes at fan inlets and outlets, in locations as required to measure pressure drops across each item in the system (e.g. outside air louvers, filters, fans,

coils, intermediate points in duct runs, etc.), and elsewhere on ductwork as indicated or required for airflow testing, measuring, and balancing. Coordinate with the Testing and Balancing Agent performing the work of Division 23 Section "Testing Adjusting and Balancing for HVAC", and provide the quantity and size of test holes where directed by the Agent.

- H. Set dampers to fully open position before testing, adjusting, and balancing.
- I. Install fire, smoke, ceiling radiation, and combination fire-smoke dampers according to the manufacturer's UL-approved written instructions. Dampers shall be selected so as to be fully compatible with the existing architectural assembly indicated in the architectural documents. Examine areas to receive dampers. Notify the Professional of conditions that would adversely affect installation or subsequent utilization of dampers. Do not proceed with installation until unsatisfactory conditions are corrected.
  - 1. Install fusible links in fire and ceiling radiation dampers.
  - 2. Provide access panels and doors in walls, ceilings, shafts, and ducts for inspection and service access.
  - 3. Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking, bowing, or other installation error.
  - 4. Handle dampers from the frame or sleeve. Do not handle by the blades, actuator, or jackshaft.
  - 5. If any installation provision or detail on the Drawings conflicts with the damper's UL listing / installation instructions, the installation instructions shall take precedence.
- J. Turning Vanes: Provide single wall turning vanes in all mitered duct elbows, except for transfer ducts and other clean air ducts with design velocities less than 750 feet per minute. Turning vanes and vane rails shall be aluminum, stainless steel, or galvanized steel, and shall match the ductwork material in which they are installed.
- K. General Duty Duct Access Door Installation: Install duct access doors on sides or bottom of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment.
  - 1. Where rectangular access doors are installed on round ducts constructed for 2" w.g. pressure class and less, provide a rectangular tap fitting to receive the rectangular door.
  - 2. Install doors at the following locations:
    - a. Both upstream and downstream of duct coils.
    - b. Downstream of VAV terminal unit coils.
    - c. Upstream from duct filters.
    - d. At outdoor-air intake plenums. Only side mounting is permitted.
    - e. At duct drain pans for duct humidifiers. Only side mounting is permitted.
    - f. Downstream from control dampers and backdraft dampers
    - g. On discharge ductwork connected to equipment (in-line and cabinet fans, fan coil units, ducted cabinet heaters, blower coil units, water source heat pumps, ducted unit ventilators, make up air units, air handling units, etc.)
      - 1) All fans and fan-containing equipment shall have a minimum of one access door on the associated ductwork.
    - h. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
    - i. At each change in direction and at maximum 50-foot spacing.
    - j. Upstream from turning vanes.
    - k. Upstream of airflow measuring stations.

- I. Upstream or downstream of other control devices requiring inspection.
    - m. Elsewhere as indicated or shown.
- L. Label access doors according to Division 23 Section "Identification for HVAC."
  - 1. Duct or plenum access doors for inspection and maintenance of fire, smoke, and combination fire/smoke dampers shall be labeled with letters not less than 1/2-inch in height that reads "FIRE/SMOKE DAMPER", "FIRE DAMPER", or "SMOKE DAMPER", as appropriate in accordance with the International Mechanical Code.
- M. Flexible Duct Installation:
  - 1. Install in accordance with Air Diffusion Council (ADC) Publication "Flexible Duct Performance And Installation Standards", 5th Edition.
  - 2. Install flexible duct with a maximum of one 90-degree bend, with a minimum of 1 duct diameter inner bend radius, unless detailed otherwise on the Drawings. Use the minimum length of flexible duct to make connections. Excess length of flexible duct shall not be installed to allow for possible future relocations of diffusers. Install ducts extended to their fullest length without compression.
  - 3. Seal insulation at both ends to maintain insulation and vapor barrier continuity.
  - 4. Do not kink flexible ducts. Supports ducts with galvanized hangers to avoid sagging.
    - a. Hanger or saddle material in contact with flexible ducts shall be of sufficient width to prevent any restriction of the internal diameter of the duct when the weight of the supported section rests on the hanger or saddle material. In no case shall the material contacting the duct be less than 1-1/2" wide.
    - b. Maximum support spacing shall be 3 feet.
  - 5. Flexible ducts shall not be used on return and exhaust systems. All exhaust and return system connections to grilles and registers shall be made with hard duct connections.
  - 6. Exposed supply ductwork spaces shall have hard/rigid duct connections to diffusers and registers.
  - 7. Flexible duct connections to diffusers are only permitted above acoustical ceilings. Do not locate flexible duct above inaccessible (drywall) ceilings. For grilles and diffusers located in drywall ceilings, provide rigid sheet metal duct connections.
  - 8. Connect flexible ducts to metal ducts and diffuser necks or slot diffuser plenums as follows:
    - a. Apply mastic approximately 2" wide uniformly around the collar of the metal fitting / duct end / diffuser neck. Mastic shall comply with UL Standard 181B and shall be marked "181B-M" on the container.
    - b. Slide at least 2" of the flex duct core over the fitting or sleeve ends and past the bead (if present).
    - c. Secure core to collar with a galvanized or stainless steel worm gear clamp applied past the bead.
    - d. Pull jacket and insulation back over core ends. Tape jacket(s) with at least 2 wraps of tape. Tape shall comply with UL Standard 181B and shall be marked "181B-FX".
- N. Flexible Connector Installation: Install flexible connectors to connect ducts to vibrating equipment. Transverse connections to ducts shall be made as specified in Division 23 Section "Ductwork" for ductwork transverse joints. Connector fabric shall not be overly compressed nor placed under tension when the fan is off or when operating at maximum speed and pressure. Provide spring links and/or fan thrust restraints where required. Seal fabric at the adjoining ends by applying outdoor grade duct sealant to overlapping fabric flaps a minimum 1" wide, rolling the flaps tight together, and securing the roll with stainless steel staples penetrating both layers of fabric and sealant, spaced 1" o.c. Attach flexible connectors to ductwork and equipment duct

connection collars using a slip-on flange duct connector system as specified in Division 23 Section "Ductwork".

1. Flexible connectors shall be omitted on ductwork connections to vibrating equipment in the following cases:
  - a. The equipment is rigidly supported or anchored, and is provided with internal flexible connector(s) and vibration isolators meeting the requirements of Division 23 Section "Vibration Controls for HVAC".
- O. Provide thrust restraints for fans as specified in Division 23 Section "Vibration Controls for HVAC".

### 3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust backdraft damper counter-balance devices to assist closing or opening as indicated or required.
- C. Adjust life safety dampers for proper action.
- D. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

### 3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  1. Operate dampers to verify full range of movement.
  2. Inspect locations of access doors and verify that purpose of access door can be performed.
  3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
  5. Operate remote balancing damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233600  
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Dual duct air terminals

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated. Include a schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished.
- B. Factory Control Package: Include information regarding features, rated capacities, furnished specialties, and accessories. Include a detailed sequence of operation, instructions for configuring, calibrating, and entering flow limit setpoints in the unit controller, and evidence of BACnet BTL listing for DDC controllers.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
  - 2. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating air outlets with other items installed in ceilings.
- B. Field quality-control reports.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: List of parts for each type of air terminal and troubleshooting maintenance guide to include in the maintenance manuals. Include instructions for resetting minimum and maximum air volumes and instructions for adjusting software set points.

## 1.6 QUALITY CONTROL

- A. Listing and Labeling: Provide electrically operated air terminals specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
- B. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- C. Comply with NFPA 70 for electrical components and installation.
- D. Testing Requirements: Test and rate air terminals according to AHRI 880, "Performance Rating of Air Terminals."
  - 1. Acoustical performance shall be adjusted for reverb test room end reflection.
  - 2. Identification: Label each air terminal with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

## PART 2 - PRODUCTS

### 2.1 DUAL DUCT AIR TERMINAL UNITS

- A. General: Provide dual duct, pressure independent air terminal units of the sizes and capacities shown on the Drawings. Note that the inlets may be of differing sizes. The unit shall be provided with independently actuated dampers and dedicated airflow measurement for each unit inlet.
- B. Construction: The unit components shall be housed within a single six-sided casing. Dual duct units formed by butting two single duct units against each other and securing them together with screws and steel sheet are not acceptable.
  - 1. Casing and Foil-faced Insulation: The unit casing shall be minimum 22 gauge galvanized steel, internally lined with minimum 3/4" thick, minimum 4 lb./cu. ft. density fiberglass ductboard insulation with a hospital-grade lining which complies with UL 181 and NFPA 90A. The lining shall be a reinforced foil facing that is smooth, non-porous, and cleanable. Exposed insulation edges shall be coated with NFPA 90A approved sealant and covered over with steel sheet. Insulation shall have flame spread and smoke development ratings not greater than 25 and 50 respectively (UL 723). Mastic or sealant-coated fiberglass or elastomeric type insulation is not acceptable. Provide a sheet metal controls enclosure to house temperature controls and damper actuator, and hanger brackets for receiving threaded rod hangers.
- C. Access Panels / Doors: Unit casing shall have an access panel to facilitate servicing of internal mechanical components. Panels shall be of sufficient size for removal of either damper as a unit, and for inspection and cleaning. The panel shall be fully removable by latches that do not require the use of tools.

- D. Dampers: Heavy gauge metal, with shaft rotating in Delrin self-lubricating bearings. Shafts shall be marked on the end to indicate the damper blade position. The dampers shall have a built-in stop to prevent overstroking and shall seal against a closed-cell foam gasket. The unit shall be capable of full shutoff and leakage through the dampers at full shut off shall be less than 1% of the maximum rated airflow at 3" w.g. inlet static pressure. The damper shall be suitable for up to 6 inches. w.g. differential pressure without damage.
- E. Factory-Furnished Direct Digital Controls (DDC): A complete controls package including a programmable digital controller, space thermostat, independent damper actuators for each deck (hot and cold), and control wiring shall be furnished and installed at each terminal unit. Controllers and piloting space thermostat shall provide for pressure independent airflow control of the terminal. Terminal units shall be factory furnished complete with a controls enclosure and multi-point center-averaging sensor with flow measurement and balancing taps to amplify velocity pressure signals and provide accurate flow sensing regardless of air inlet duct configuration on each of the two (2) inlet duct connections. Each airflow sensor shall have not less than four (4) monitoring ports, and monitoring ports shall not be in series. Provide a control transformer at each terminal.
1. The controller shall be a BACnet controller, BTL listed and certified as a VAV terminal unit application specific controller (i.e. B-ASC certification).
  2. The control parameters, including minimum and maximum airflow setpoints (for both heating and cooling modes) and space temperature setpoints (for both occupied and unoccupied modes), shall be configurable and established using the space thermostat with the use of resident programming, and without the use of proprietary software or service tools.
  3. Furnish a copy to the Client Agency of the programming software tools, passwords, programming guides, and all other information and software required to permit possible future re-programming of the unit controllers and integration into a building-wide DDC system over an BACnet MS/TP network. Software and other electronic data shall be furnished on a DVD or USB flash memory drive
  4. Space Thermostats: Thermistor or RTD type with +/- 0.5 deg. F. accuracy, user space setpoint adjustment and LCD readout with keypad or touchscreen, temperature indication, and password protection.
  5. Damper Actuators: Electric, direct mount. NEMA 1 enclosure. 24VAC tri-state type. Damper actuators may be integral to the controller.
    - a. Stroke Time: Maximum 5 minutes end to end full stroke.
    - b. Control Input: 0-10 VDC
  6. Sequence of Operation:
    - a. Cooling Mode: On a rise in room temperature above the cooling setpoint, the hot deck damper shall be fully closed, and the cold deck damper shall modulate open, up to the maximum cooling airflow rate, as scheduled on the Drawings. The minimum cold deck airflow in this mode shall be the minimum supply/deadband airflow scheduled.
    - b. Heating Mode: On a fall in room temperature below the heating setpoint, the cold deck damper shall be fully closed, and the hot deck damper shall modulate open, up to the maximum heating airflow rate, as scheduled on the Drawings. The minimum hot deck airflow in this mode shall be the minimum supply/deadband airflow scheduled.
    - c. Deadband Mode: When the room temperature is half-way between the heating and cooling setpoints (i.e. the control band center-point), the hot deck and cold deck airflows shall be equal, and shall each be on-half of the minimum supply/deadband airflow rate scheduled on the Drawings. As the temperature deviates up or down from the control band center-point, the ratio of hot deck and cold deck airflows shall



be varied in proportion to the space temperature deviation from the control center-point, while maintaining the total unit airflow at a constant value equal to the ventilation minimum value.

- d. Room Unoccupied Mode Temperature Control: The dual duct VAV terminal unit shall be controlled as described above for the room occupied mode, except the minimum/deadband airflow rate shall be zero (0) cfm, unless indicated otherwise on the Drawings, and the unoccupied space heating and cooling temperature setpoints shall be observed.
- F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 1. Titus ('EDV' Series)
  - 2. Kreuger HVAC
  - 3. Price Industries ('DDV' Series)
  - 4. Johnson Controls
  - 5. Tuttle and Bailey
  - 6. Greenheck
  - 7. Or equal as approved by the Professional.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install air terminals level and plumb, according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards; and maintain sufficient clearance for normal service and maintenance. Support terminals separately from the connecting ductwork from overhead building structural steel. Do not support from ceiling grid or from the connecting ductwork. Comply with Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Hang terminal units that do not contain fans using four (4) threaded rods and factory-installed terminal unit hanger brackets or minimum 22 gauge galvanized sheet metal strap hangers, secured to the unit casing with two (2) sheet metal screws each, one on the side and one on the bottom of the casing. Threaded rod shall be used where terminals are exposed to view in finished spaces.
- C. Duct installations and connections are specified in Division 23 Section "Ductwork".
- D. Provide the manufacturer's recommended straight length of inlet ductwork on the primary air connection.
- E. Provide an access door on both sides of reheat coils for inspection and cleaning access. The access panel / door on the terminal unit casing may suffice for one of the two (2) required doors.
- F. Identify units according to Division 23 Section "Identification for HVAC."
  - 1. Identification: Label each air terminal with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type and rated capacity, and AHRI certification seal.
  - 2. Mark the ceiling grids identifying the location of terminal units.

### 3.2 CONNECTIONS

- A. Provide plenum rated control wiring, or non-plenum rated wiring in raceway, between field mounted sensors and thermostats that the respective unit controllers.
- B. Electrical: Comply with applicable requirements in Division 26 Electrical.
- C. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.3 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

### 3.4 FIELD QUALITY CONTROL

- A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Verify that installation of each air terminal is according to the Contract Documents.
- C. Check that inlet duct connections are as recommended by air terminal manufacturer to achieve proper performance.
- D. Check that controls and control enclosure are accessible.
- E. Verify that control connections are complete.
- F. Check that nameplate and identification tag are visible.
- G. Functionally test all portions of the sequence of operation.
- H. Verify that controls respond to inputs as specified.
- I. Calibrate the airflow controller and flow sensor at both design minimum and maximum airflow rates during air testing and balancing.

### 3.5 DEMONSTRATION

- A. Train Client Agency's maintenance personnel as specified below:
  - 1. Train Client Agency's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
  - 2. Review data in the maintenance manuals.

3. Schedule training with Client Agency, through the Department, with at least 7 days' advance notice.

END OF SECTION 233600

## SECTION 233713

### DIFFUSERS, REGISTERS, AND GRILLES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. This Section includes ceiling- and wall- and duct- mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
  - 1. Division 23 Section "Air Duct Accessories" for:
    - a. Manual balancing dampers not integral to diffusers, registers, and grilles
  - 2. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for balancing diffusers, registers, and grilles. This section also includes requirements for airflow pattern adjustments.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each model indicated, include the following:
  - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
  - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
  - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
  - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
  - 5. Samples for Color Selection: For diffusers with factory-applied color finishes other than white.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

## 1.5 QUALITY CONTROL

- A. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."
- B. Diffusers and grilles shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

## PART 2 - PRODUCTS

### 2.1 DIFFUSERS

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as specified and as required for complete installation.
- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Ceiling Compatibility: Provide diffusers with border styles and accessory frames that are compatible with adjacent ceiling systems and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- D. Types: Provide ceiling diffusers of types, capacities and with accessories and finishes as required to provide capacities and performance requirements indicated on the Drawings.
- E. Ceiling Diffusers, Modular, Louvered: Diffusers shall be of the 24 inch by 24 inch modular design with directional full louvered face extending over the entire exposed surface of the diffuser, for all diffuser sizes, to provide uniformity of appearance. Provide a square to round neck transition for the neck sizes indicated on the Drawings. Diffuser shall have a back plate and sheet metal collar constructed of steel, with factory painted off-white baked enamel or anodic acrylic finish. Diffusers shall be designed for installation in a lay-in tile ceiling grid system or in a drywall ceiling with plaster frame accessory provided. Provide a volume control damper at each supply diffuser. Louvers shall be arranged to provide 1, 2, or 3-way throw patterns where indicated on the Drawings.
- F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
  - 1. Ceiling Diffusers, Modular, Louvered:
    - a. Price Industries
    - b. Titus (Series 'TDC/TDCA').
    - c. Greenheck
    - d. Krueger HVAC
    - e. Metalaire
    - f. Tuttle and Bailey
    - g. Or equal as approved by Professional.

## 2.2 REGISTERS AND GRILLES

- A. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as specified and as required for complete installation.
- B. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop and noise criteria ratings for each size device and listed in manufacturer's current data.
- C. Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall and ceiling systems and that are specifically manufactured to fit into wall and ceiling construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall and ceiling construction which will contain each type of wall register and grille.
- D. Types: Provide registers and grilles of type, capacity and with accessories and finishes as required to provide capacities and performance requirements indicated on the Drawings.
- E. Exhaust, Relief, Transfer and Return Air Bar Grilles and Registers:
  - 1. Grilles and registers shall be securely attached and supported from associated ductwork or, where not duct connected, shall be attached and supported from the building structural system. Grilles and registers shall not be supported by ceilings of any type.
  - 2. Grilles and register faces shall have off-white baked enamel or anodic acrylic factory painted finishes.
  - 3. Generally, grilles shall be fabricated from steel and have horizontal steel louvers, spaced 3/4" on centers and fixed at 35 degrees deflection.
  - 4. Registers shall be provided with an opposed blade balancing damper, adjustable from the register face, fabricated from either steel or aluminum (to match the grille), with a white prime coat finish.
- F. Aero Blade Supply Air Bar Grille Registers:
  - 1. Provide supply air registers consisting of double deflection arrangement with individually adjustable vertical front blades and individually adjustable horizontal back blades with frames. Blades shall have an airfoil shaped cross section, and shall be solid (not hollow). Supply registers shall be finished as specified above for exhaust and return grilles and registers.
  - 2. Supply registers shall be constructed of steel.
  - 3. Supply registers shall be provided with an opposed-blade balancing damper, adjustable from the register face, and fabricated from either steel or aluminum (to match the grille), with a white prime coat finish.
- G. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
  - 1. Exhaust, Relief, Transfer and Return Air Bar Grilles and Registers:
    - a. Price Industries.
    - b. Titus (Series 350RL / 350FL)
    - c. Greenheck
    - d. Krueger HVAC
    - e. Metalaire
    - f. Tuttle and Bailey

- g. Or equal as approved by Professional.
2. Aero Blade Supply Air Bar Grilles and Registers:
- a. Price Industries.
  - b. Titus (Series 272RS / 272FS).
  - c. Greenheck
  - d. Krueger HVAC
  - e. Metalaire
  - f. Tuttle and Bailey
  - g. Or equal as approved by Professional.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify the Architectural for a determination of final location. Support grilles registers and diffusers located in ceilings from overhead building structural steel or from ductwork. Do not support from ceiling system.
- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC".

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713



## SECTION 238126

### SPLIT-SYSTEM HEAT PUMPS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 ADDITIONAL RELATED DOCUMENTS

- A. Division 23 Section "Refrigerant Piping" for additional requirements related to refrigerant piping.
  - 1. If any content of the "Refrigerant Piping" section conflicts with the specific requirements or recommendations of the split system manufacturer, those manufacturer's recommendations and requirements shall take precedence.
- B. Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for hangers and supports for equipment and piping, and for roof support systems.

##### 1.3 SUMMARY

- A. This Section includes split-system air-conditioning (cooling only) units consisting of separate evaporator-fan and compressor-condenser components.
  - 1. Indoor units are designed for exposed or concealed mounting, and may be connected to ducts, or may be ductless, as indicated.
- B. The refrigerant piping system shall be designed by a manufacturer's certified designer for the Contractor. The cost of this work shall be included in the Contractor's bid price.
- C. The Contractor is hereby advised of the fact that refrigerant piping design (sizes (if noted), quantities, etc.) indicated on Drawings is for illustrating general coordination and required routing purposes only.
  - 1. It is the Contractor's responsibility to provide a complete and functional system and to perform final pipe sizing and design the actual piping layout, including double risers, traps, and other specialties recommended or required by the equipment manufacturer or indicated in this specification or shown on the Drawings.
  - 2. This final design verification shall be performed by the Contractor as a part of the process of generating shop drawings, taking into consideration, as a minimum, the actual equipment provided, the verified elevation difference between the outdoor unit and indoor units, and the total equivalent length of piping represented on the shop drawings to ensure proper operation and compliance with warranties of connected equipment.
  - 3. The submitted cooling and heating capacities of the indoor and outdoor units shall be corrected for the final design layout / line lengths.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
  - 1. Rated capacities shall be for the complete, integrated system proposed, including the submitted evaporator coil and condensing unit.
  - 2. The type and mass of each system's refrigerant charge, and the ARHI gross rated cooling capacity of each system. Provide the information in tabular form.
  
- B. Shop Drawings:
  - 1. Diagram power, signal, and control wiring.
  - 2. Refrigerant piping diagrams and plans detailing sizes, fittings, valves and other pipeline appurtenances, and methods of support. Include a letter from the manufacturer that the work depicted on the piping shop drawings for this project meets all of the manufacturer's requirements and recommendations.
    - a. Equipment connection details: Show interface and spatial relationships between piping and equipment.
    - b. The Contractor shall submit a letter from the manufacturer of the equipment attesting that the shop drawing refrigerant piping layout, piping appurtenances, piping sizes, etc. are in accordance with the manufacturers' recommendations and requirements.
    - c. Include calculations showing that system travel distance for refrigerant piping and controls cabling are within horizontal and vertical travel distances set by manufacturer. Provide a comparison table for each system installed.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
  
- B. Warranty: Special warranty specified in this Section.

#### 1.7 QUALITY CONTROL

- A. The Installing Contractor shall be designated by the equipment manufacturer as a Certified Installer and shall also be certified to perform startup by the manufacturer.
  
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  
- C. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2016, "Energy Standard for Buildings except Low-Rise Residential Buildings."

- D. The system shall be rated for thermal performance and efficiency per applicable ARHI Standards.
- E. Air conditioning condensate drain pans and the inside of indoor unit surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- F. Single Source Responsibility: A single manufacturer shall be responsible for the integrated performance of the air conditioning unit / evaporator coil and associated refrigerant condensing unit / condenser or dry cooler. The components shall be factory engineered and integrated as a single, functional system to meet the scheduled and specified performance. The field-pairing of system components provided by or through more than one manufacturer is not acceptable.

#### 1.8 COORDINATION

- A. Coordinate installation of roof support rails for mounting units. Roof support rails are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment".
- B. Coordinate installation of wall brackets for mounting outdoor units.
- C. Refer to Division 23 Section "Refrigerant Piping" for refrigerant piping materials, joining methods, and accessories.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units which fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five (5) years from date of Substantial Completion.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in a clean and dry place.
- B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
- C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.
- D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
  - 1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
  - 2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.
- E. Replace installed products damaged during construction.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Daikin - Basis of Design
  2. Mitsubishi.
    - a. Identical systems furnished through Trane are also acceptable.
  3. Carrier.
  4. Fujitsu.
  5. York/ JCI.
  6. LG.
  7. Lennox.
  8. Samsung.
  9. Reznor.
  10. Or equal as approved by the Professional.

### 2.2 WALL-MOUNTED DUCTLESS INDOOR UNITS

- A. General: The indoor unit shall be factory assembled, wired and run tested. The unit shall be designed for wall mounting using a separate back plate. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, refrigerant air coil, control circuit board, and fan motor. The unit shall have a supply outlet with adjustable directional louvers. The casing shall have a white finish.
1. Drain Pans: Stainless steel or thermoplastic, with connection for drain and insulated. A drain pan overflow switch shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. Fan: Direct drive, centrifugal fan. Motor shall be multispeed with internal thermal protection and permanent lubrication.
- D. Condensate Pump: Provide a condensate pump for each unit as specified in the Article "Condensate Pumps" below in this Section.
- E. Filters: Permanent, cleanable.
- F. Electrical: Integral NEMA 1 enclosure for wiring terminations.

### 2.3 CONDENSATE PUMPS

- A. Indoor Units: Up to 1 Ton Nominal Total Cooling Capacity: As specified immediately below for units from 1.25 to 3.5 tons capacity, but the pump shall be capable of no less than 6 feet of suction lift, and shall be rated for no less than 0.5 GPH (gallons per hour) at a suction lift of 6 feet and a

discharge head of 12 feet. Pumps with integrated water detection and lacking separate suction reservoirs are also acceptable.

1. Acceptable Products: Blue Diamond Pumps 'MicroBlue with reservoir', Sauermann 'Si10', 'Si20', or 'Si30', Aspen Pumps Group 'Mini Aqua' or 'Mini Orange', or approved equal.
- B. Indoor Units: From 1.25 to 3.5 Tons Nominal Total Cooling Capacity: Consisting of a reservoir connected to the indoor unit condensate drain connection and a pump that can be remote mounted from the indoor unit.
1. Reservoir: Condensate collection chamber with connections for tubing. Mounted inside indoor unit, incorporating an operating level sensing device and control contacts for pump operating control and high limit alarm levels.
  2. Pump: Positive displacement, self-priming type, suitable for water up to 104 deg. F. Capable of no less than 6 feet of suction lift. Rated for no less than 1.5 GPH (gallons per hour) at a suction lift of 6 feet and a discharge head of 20 feet. On-off control of the pump shall be from the operating level switch in the reservoir.
    - a. Mounting: For wall mounted units in spaces with no finished ceiling, mount the pump inside the unit or next to the unit.
    - b. Acceptable Products: Blue Diamond Pumps Inc. 'MaxiBlue with reservoir', Sauermann 'Si20' or 'Si30', or Aspen Pumps Group 'Mini Aqua' or 'Mini Orange', or approved equal.
- C. Electrical: Pumps shall be powered from the respective indoor unit's low voltage terminal strip. Wire as required by the indoor unit manufacturer.
- D. High Water Shut Down Control: Wired to unit controls to shut down indoor unit in cooling mode upon reaching a high condensate level.

## 2.4 OUTDOOR AIR-SOURCE, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Steel, finished with baked enamel in the manufacturer's standard color, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing for connecting refrigerant piping to the indoor unit.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
1. Compressor Type: Inverter-driven scroll.
  2. Manual-reset high-pressure switch and automatic-reset low-pressure switch.
  3. Refrigerant: R-410A, R-32, and R-454B
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
1. All-aluminum microchannel type coils consisting of a series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds are also acceptable.
- D. Fan: Aluminum or molded plastic propeller type, directly connected to motor.

1. Head pressure control to modulate condenser fan motor speed for low ambient conditions.
  2. Raised guard to prevent contact with moving parts.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.
- F. Snow and Ice Protection: Provide the following accessories for the units:
1. Snow and Hail Guards: The coil air intake shall be protected with a snow and hail guard. The top of the unit shall be protected by a snow and hail hood. The hood and guards shall be manufactured from min. 20 gauge galvanized steel provided with a factory finish matching the rest of the unit.
- G. Low Ambient Cooling Kit: Permits 100% of rated cooling capacity operation down to zero (0) deg. F. Include condensing unit wind baffles and all other required controls and accessories.
- H. Cooling Mode Outdoor Ambient Temperature Tolerance Range: Construct the units to tolerate operation in an outdoor air temperature as high as 115 deg. F. Provide a high ambient package as required to accommodate this range. De-rating below the scheduled capacity and efficiency is acceptable at the high ambient temperature.
1. The outdoor ambient temperature for rating the unit capacity and efficiency shall be as scheduled on the Drawings or 105 deg. F, whichever is higher.

## 2.5 CONTROLS AND ACCESSORIES

- A. Thermostat: Wall-mounted and hard wired to the indoor unit with a user interface, to control the system, including compressor(s) and evaporator fan(s). Controls shall incorporate the following additional features:
1. Compressor time delay.
  2. 24-hour time control of system stop and start.
  3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  4. Fan-speed selection, including auto setting.
- B. Automatic-reset timer to prevent rapid on-off cycling of compressor.
- C. Provide a hard-start kit to enable proper startup of the compressor in accordance with the manufacturer's recommendations to suit the refrigerant line lengths of each installation of this project and the design outdoor ambient condition scheduled on the drawings or 95 degrees F., whichever is higher.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances, other specific conditions, and other conditions affecting performance of split systems. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine products before installation. Reject products that are wet, moisture damaged, or mold damaged.

- C. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PROTECTION

- A. Protect products from moisture and water damage. Remove and replace products that are wet, moisture damaged, or mold damaged.
- B. Protect equipment from physical damage. Replace equipment with physical damage that cannot be repaired to new condition. Observable surface imperfections shall be grounds for removal and replacement.
- C. Protect equipment from electrical damage. Replace equipment suffering electrical damage.
- D. Cover and seal openings of equipment to keep inside of equipment clean. Do not remove covers until finish work is complete.

### 3.3 INSTALLATION

- A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- B. Install indoor units using manufacturer's standard mounting devices securely fastened to building structure.
- C. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.
- D. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.
- E. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
- F. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
- G. Install outdoor units on wall brackets, with the bottom of the unit approximately 30" above grade or finished roof surface, unless noted otherwise on the Drawings. Brackets shall be constructed of stainless steel, or power coated galvanized steel, and shall be secured to the wall with no less than four (4) anchor bolts. Bolts shall be secured to the wall structure. Brackets shall be supplied by the split system manufacturer or by DiversiTech Corp. Provide supplemental wind restraints.
- H. Install roof mounted outdoor units on prefabricated roof supports. Refer to Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for prefabricated support rails. Provide supplemental wind restraints. Refer to the wind restraint detail on the Drawings.
- I. Install outdoor units on restrained spring vibration mounts with a minimum of 1" static deflection. Locate the isolators between the roof rails and the outdoor unit. Refer to Division 23 Section "Vibration Controls for HVAC."

- J. Labeling: Provide equipment identification and piping labels as specified in Division 23 Section "Identification for HVAC". On indoor units in finished spaces, locate equipment labels on normally concealed surfaces. On outdoor units located at grade, locate equipment labels on the back of the units away from public view.
  - 1. Branch refrigerant piping between outdoor units and indoor units shall be labeled with the number/name of both the associated outdoor unit and the indoor unit.
  - 2. Indoor unit equipment labels shall include to which outdoor unit it is connected.
  - 3. Outdoor unit equipment labels shall include to which indoor unit(s) it is connected.

### 3.4 CONNECTIONS

- A. Install and connect refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- B. Piping connections to units provided with externally applied vibration isolation shall include flexible connectors. Conduit connections shall use flexible watertight conduit.
- C. Install piping adjacent to unit to allow service and maintenance.
- D. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas. Exception: Do not install piping and conduit in concrete masonry (CMU) walls.
  - 1. Lineset Covering Systems: Provide a complete lineset covering system as specified in Division 23 Section "Refrigerant Piping" to conceal refrigerant piping, and control conduits and AC condensate piping associated with the same refrigeration / cooling equipment, where the refrigerant piping is located in a finished space below a finished ceiling.
- E. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.
- G. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors.
- H. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors.
- I. Add additional refrigerant and oil as required for the as-installed system.
- J. Provide power and control wiring as per the manufacturer's requirements between each indoor unit and the outdoor unit. Comply with applicable Division 26 requirements.
  - 1. Provide a disconnect switch at each indoor unit for any power and control wiring that is not low voltage (i.e. not 24V or less).
- K. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
  - 1. Provide refrigerant piping in accordance with Division 23 Section "Refrigerant Piping."
    - a. Exception: Where refrigerant piping runs are 50 feet or less (one way) and no portion of the piping is visible in finished spaces or is located outside, the Contractor may



use pre-insulated refrigerant piping line sets that use annealed temper copper tubing manufactured specifically for refrigeration service. All other runs of refrigerant piping shall use hard tempered copper tubing specified in Division 23 Section "Refrigerant Piping". Line sets shall comply with the following:

- 1) Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed.
  - 2) Line sets may be used indoors only, unless additional field-applied insulation and jacketing as specified in Division 23 Section "HVAC piping Insulation" is provided.
  - 3) Lines shall be pre-insulated with EPDM-based flexible elastomeric or low density polyethylene insulation, minimum 1-inch thick, with a minimum R-value of 3.7. Provide additional thickness if required to meet his minimum R value. Insulation shall be plenum rated per the International Mechanical Code.
- L. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- M. Install piping adjacent to unit to allow service and maintenance.
- N. Condensate Drain Connections: Provide a condensate drain trap on the indoor unit condensate drain connection. If the unit manufacturer does not recommend a trap, an in-line type check valve shall be provided on the drain line.
- O. Condensate Pumps: All indoor units shall be provided with a condensate pump, unless explicitly indicated otherwise.
- P. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls. Ground equipment according to Division 26 provisions.

### 3.5 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Clean units to remove dirt and construction debris and repair damaged finishes.

### 3.6 FIELD QUALITY CONTROL, COMMISSIONING, AND START UP SERVICE

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  4. The following operational tests, at the minimum, shall be performed and documented:
    - a. Cooling mode - each indoor unit.
    - b. Power loss and automatic restart

- c. Condensate pump operation - each applicable unit.
- d. Verification of vane direction - each applicable indoor unit.
- e. Verification of fan speed - each indoor unit

C. Remove and replace malfunctioning units and retest as specified above.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Client Agency's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01.

END OF SECTION 238126

## SECTION 260500

### COMMON WORK RESULTS FOR ELECTRICAL

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Electrical equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Painting.
  - 4. Access panels.
  - 5. Common electrical installation requirements.
  - 6. Joint Sealers.

##### 1.3 DEFINITIONS

- A. Approved Equal: The term "approved equal", "approved", "equal", "equivalent", etc. shall mean equal in all respects in the opinion of the Architect.
- B. As Required: The term "as required" refers to making final connections to and/or coordinating with the appropriate authorities regarding the installation of the indicated equipment.
- C. Contractor: The term "Contractor", "this Contractor" or "Electrical Contractor" when used in the Contract Documents refers to the Contractor responsible for all work specified in Division 16 and as indicated on the Electrical Drawings.
- D. Directed: Terms such as "directed," "requested," "authorized," "selected," and "permitted" when used separately without referencing any authority, shall mean directed by the Architect, requested by the Architect, and similar phrases.
- E. Disconnect: Disconnect electrical service to indicated items. Associated conduit and wire shall be disconnected and removed, complete, back to its source. Where electrical equipment (i.e. generator) is connected to radiator, fuel, and exhaust piping, intake and exhaust ductwork, etc., this Contractor shall disconnect and remove all associated appurtenances, complete, back to their source unless noted otherwise.
- F. Existing to Remain: Protect construction and/or indicated items to remain against damage and soiling during selective demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

- G. Finished/Unfinished Space: The term "finished space" shall mean areas where drywall is hung and installed with wall coverings and/or painted, floors are polished or coverings are installed on the floor, and the ceiling is plaster/gypsum board and/or suspended A.C.T. The term "unfinished space" refers to any area that does not meet the definition for a "finished space" as specified above. Mechanical rooms, electrical rooms, garages, etc. are typically considered "unfinished spaces".
- H. Furnish: The term "furnish" when used separately, shall mean to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations by others.
- I. Indicated: The term "indicated", "shown," "noted," "scheduled," and "specified" refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents.
- J. Install: The term "install" when used separately, shall mean to mount in place, connect and make operable. Installation operations at the Project site shall include, but not be limited to, the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- K. Provide: The term "provide" when used in these specifications, shall mean to furnish and install, complete and ready for the intended use. See above definitions for additional requirements.
- L. Regulations: The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- M. Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.
- N. Remove: Remove and legally dispose of items except those indicated to be reinstalled or salvaged or to remain the Client Agency's property as directed.
- O. Salvage (Turn Over to Client Agency): Items indicated to be salvaged remain the Client Agency's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Client Agency's designated storage area.
- P. Subcontractor: The term "Subcontractor" when used in these Contract Documents refers to an experienced installer (i.e. manufacturer, vendor, etc.) whom has successfully completed a minimum of five (5) previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction. Any reference to, or letting of work contained in these Contract Documents to any Subcontractor does not relieve this Contractor of his/her responsibility for all work, material and equipment indicated in these Contract Documents.
- Q. Work: The term "work" refers to all labor and materials provided by the Contractor and/or Subcontractor to make a complete and operable system.

#### 1.4 SUBMITTALS

- A. In addition to the requirements of Division 1, the Contractor shall provide product data and shop drawings for all materials proposed for installation under this Contract. The product data and shop drawings shall be submitted to the Architect for approval before such equipment is delivered to the site. The Contractor shall submit samples as may be required by the Architect of any article

or materials to be used under this Contract, which samples, if approved, may be used on the work after serving their purpose as samples.

- B. Identify submittals with the following information permanently adhered to or noted on each separate component of each submittal and also noted on the transmittal form. Mark each copy of each submittal identically, with the following:
  - 1. Project title and location.
  - 2. The Section number of the Section by which the proposed equipment is specified.
  - 3. The Drawing number or numbers of the Drawing or Drawings by which the proposed equipment is indicated.
  - 4. The name, address and telephone number of the supplier and the associated manufacturer.
  - 5. Submittals presented on sheets 8-1/2" by 14" or less shall be presented as part of a bound volume.
- C. Refer to the article titled "SUBSTITUTIONS" for all products which are not specified by manufacturer and catalog number and are intended to be submitted.
- D. Product Data: For electricity-metering equipment.
- E. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
- F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- G. The Contractor shall submit samples as may be required by the Architect of any article or materials to be used under this Contract, which samples, if approved, may be used on the work after serving their purpose as samples.
- H. A complete list of materials proposed for installation shall be submitted to the Architect for approval before delivery to the site. Shop drawings, manufacturers' descriptions, and cuts of fixtures and other equipment shall be submitted to the Architect for approval before such fixtures or equipment are installed and before any item is roughed-in for same.
- I. Where the phrase "or approved equal," "or equal," or "approved" appears, it shall refer to the approval of the Architect on the materials or equipment involved.

## 1.5 SUBSTITUTIONS

- A. The submissions are the Contractor's documents and the Architect's approval constitutes an acknowledgment that the documents have been submitted and nothing more. It is the Contractor's responsibility to check his own submissions for compliance with the Contract Documents and job conditions.
- B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalog number in order to establish standards of quality and performance and not for the purpose of limiting competition. Unless specifically stated otherwise, the bidder may assume the phrase "or approved equal," except that the burden is upon the bidder to prove such equality. If the bidder elects to prove such equality, he must request the Architect's approval in writing to substitute such item for the specified item, and shall submit supporting data, and samples if required, to permit a fair evaluation of the proposed substitution with respect to quality, serviceability and warranty.

- C. When this Contractor desires to furnish equipment of a manufacturer other than that specified or intended, he shall include a complete specification of the substituted item, along with each submission copy of shop drawings, indicating the necessary modifications to the substituted product to satisfy the requirements of the contract specifications. Manufacturer's specifications shall be written as close as possible over the contract specifications and each paragraph shall bear the same paragraph number as the contract specifications so that close comparison can be made.
- D. The verification specification shall include the exact wording of the contract specification and the revised wording identified properly indicating all the deviations proposed. Each paragraph shall be denoted as "TOTALLY COMPLIES", "PARTIALLY COMPLIES", or "DOES NOT COMPLY". If no deviations are noted, the Contractor must furnish the material or equipment in accordance with the contract specifications.
- E. Also, when the Contractor submits equipment or materials of the manufacturers specified, verification specifications must be submitted at the request of the Architect.
- F. The Contractor is responsible for confirming that all specified products will be available in a timely manner to meet the contract schedule. Should the delivery time schedule of any specified product be an issue that could adversely affect the project schedule, the Contractor shall notify the Architect, in writing, within 14 days following the award of the Contract. Documentation as to when specified products were ordered and anticipated delivery dates will be required to be submitted to the Architect at this time. Failing to comply with this paragraph will prohibit the Contractor from substituting a specified product based on delivery time issues.

#### 1.6 QUALITY CONTROL

- A. Labels and Listings: "Labels and Listings" for appliances and equipment provided meet the requirements of the Underwriters Laboratories, Inc. (UL), Electrical Testing Laboratories (ETL) and other standards organizations.
- B. National Fire Protection Association (NFPA): All work provided under this Contract shall meet the requirements of NFPA 70, "National Electrical Code," latest edition.
- C. Seismic Requirements: Provide equipment anchoring and support to resist shear and overturning moments.
- D. Current Models:
  - 1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.
  - 2. Replacement parts shall be available.
  - 3. There shall be a permanent service organization maintained or trained by the manufacturer to provide satisfactory service.
- E. Experience: Manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than three years prior to the date of bid opening for this project.

#### 1.7 PROJECT CONDITIONS

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Client Agency or others unless permitted under the following conditions:

1. Notify the Client Agency, Architect, and construction manager no fewer than 14 days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Client Agency's, Architect's, and Construction Manager's written permission.
3. Comply with NFPA 70E.

## 1.8 GENERAL STIPULATIONS

- A. The Contractor shall furnish all labor, materials, tools, scaffolding and other equipment necessary to provide the complete electrical system in accordance with the accompanying drawings and these specifications. The Contractor will be responsible for the completion of all work included under this Contract and shall employ skilled and qualified tradesmen as necessary to satisfy all work and trades.
- B. In all cases where equipment and materials are specified in the singular or plural number, it is intended that such reference shall apply to as many such items as are required to complete the installation.
- C. Except as otherwise defined hereinafter, the term "furnish" is used to mean supply and deliver to the project site and readied for installation. Except as otherwise defined hereinafter, the term "install" is used to describe furnishing and manufacturing and operations at the project site, including furnishing, unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance. Except as otherwise defined hereinafter, the term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.
- D. The terms "The Contractor," "This Contractor," or "The Electrical Contractor" mentioned in these specifications refers to the Electrical Contractor responsible for the work and equipment included in these specifications.
- E. Equipment of similar types shall be of the same manufacturer except where specifically indicated otherwise.
- F. Where the Contractor elects to substitute materials or equipment approved by the Architect for those specified, the Contractor will be held responsible for all structural, mechanical, and electrical changes required for the installation of the substituted materials at no additional cost to the Client Agency.
- G. When the Contractor proposes to use an item or equipment other than that specified or detailed on the Drawings, that is approved by the Architect and that requires re-design of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, then such re-design, new drawings, and detailing required for it shall be prepared by the Contractor without additional compensation.
- H. The Contractor shall procure all necessary permits to carry out his work. He shall also arrange for all tests required on any and all parts of his work by local authorities, paying all regular and proper charges for same. He shall also obtain all certificates of inspection and approval from all required authorities and the Underwriters. Underwriters' certificates in duplicate shall be furnished to the Client Agency at the completion of the Project. Also, the Electrical Contractor shall furnish two copies of each intermediate Underwriters' inspection report to the Architect and the Client Agency. All fees and permits required shall be satisfied and obtained by this Contractor and the cost shall be included in the Contract price.

- I. Nothing contained in these specifications or shown on the drawings shall be so construed as to conflict with any local, county, municipal, federal, or state laws or regulations governing the installation of electric or other work specified herein, and all such ordinances and regulations, including the National Electrical Code are hereby incorporated and made a part of these specifications. All work shall be constructed and installed in accordance with the requirements of the local municipality, the appropriate County, OSHA, NFPA, ANSI (A117.1-1986) for the physically handicapped, Americans With Disabilities Act (ADA) and the Department of Labor "Safety and Health Regulations for Construction", and Pennsylvania Legislative Act 187 (Pennsylvania One-Call System). All such requirements shall be satisfied by the Contractor and at no additional expense to the Client Agency. The electrical systems shall be installed in accordance with the General Building Code as established by the Building Officials Administrators International, Inc. (BOCA). In addition to compliance to the above regulations and requirements, the following standards, regulations and requirements shall be met: IEEE, Factory Mutual Engineering Corp., National Bureau of Standards, National Electric Safety Code and National Fire Protection Association. Local codes shall take precedence over the drawings and specifications, except where the Contract Documents are more stringent the Contract Documents shall apply.
- J. The system shall be effectively grounded, and the insulation shall be made sufficiently perfect so that there will be an insulation resistance between all conductors and the ground of not less than required by the National Electrical Code.
- K. The Contractor shall furnish and place all sleeves required for conduits passing through floors, beams, walls and ceilings before such general construction work is built into place. The Electrical Contractor shall place all inserts required for hangers and supports, as the general construction progresses, so that unnecessary cutting of construction work will be eliminated.
- L. Upon completion of the work, equipment, wire, cables, conduit not remaining as part of the remodeled system and all remaining waste materials and rubbish resulting from the Contract work shall become the property of the Contractor and shall be immediately removed from the building and premises by the Contractor.
- M. When the installation is reported in writing by the Contractor to be complete and ready for acceptance, tests and inspection shall be made by the Contractor in the presence of representatives of the Architect to ascertain whether it complies with the specifications and Contract, and upon its failure to do so, the Contractor shall at once remedy all defects and shortcomings, and any additional tests that may be required shall be entirely at the Contractor's expense.
- N. All of the testing work shall be done when and as directed by the Architect before the system is accepted.
- O. Due to the small scale of the drawings, it is not possible to indicate all conduits, conductors, fittings, boxes, switches, and similar parts which may be required. The drawings are generally indicative of the work to be installed. The Contractor shall investigate the structural and finish conditions affecting the work and arrange all work accordingly, furnishing such parts and equipment as may be required to meet building conditions.
- P. Contractor shall lay out his work from dimensions of Architectural and Structural Drawings and actual dimensions of equipment being installed. Layouts in congested areas should not be scaled from Mechanical and Electrical Drawings.
- Q. The right is reserved to make any reasonable change in the locations of conduits, outlets and equipment prior to roughing-in, without involving additional expense to the Client Agency. The Contractor shall include a suitable allowance in his bid price for the above.



- R. Make final electrical connections to equipment furnished under other contracts except where specifically indicated otherwise.
- S. Where the building insulation or vapor barrier is broken due to the installation of hangers, conduits, boxes or other equipment, properly repair the insulation and seal the openings with vapor barrier covering and vapor barrier adhesive.
- T. In the instance of electronic and/or programmable equipment and systems furnished and installed under this Contract, all final connections and testing of the equipment and systems shall be made under the direct supervision of competent authorized service engineers who shall be employed by the respective equipment manufacturer and/or an authorized and competent representative. Any and all expenses incurred by these equipment manufacturer's representatives shall be borne by the Contractor.
- U. The Contractor shall have a managerial representative at each and every regularly scheduled job conference to receive the items that are furnished by others, to inventory them and coordinate his work with the other trades.
- V. This Contractor shall be entirely responsible for all apparatus, equipment, and appurtenances furnished under this Contract in connection with the work, and special care shall be taken to protect all parts thereof in such a manner as may be necessary or as may be directed. Protection shall include covers, crating, sheds, or other means to prevent dirt, grit, plaster, or other foreign substances from entering the working parts of machinery or equipment. Special care shall be taken to keep all open ends of conduits and other equipment closed while in storage and during the course of installation. Where equipment must be stored outside the building, it shall be totally covered and secured with heavy waterproof tarps and kept dry at all times. Where equipment has been subjected to moisture, it shall be suitably dried out before placed in service. All apparatus, equipment, conduit and other appurtenances shall be stored in areas designated by the Architect.
- W. The Contractor shall be responsible for coordinating with all Utility Companies that will provide services to this job site. This Contractor shall communicate with each and every public utility company and incorporate into the project's scope of work all Utility requirements for this project. This shall include, but not be limited to, all fees, materials, equipment, conduits, conductors, excavation, service charges, etc.

## 1.9 REGULATIONS

- A. All laws, ordinances, rules and regulations of public bodies bearing on the conduct of the work are hereby incorporated and made a part of these specifications.
  - 1. Americans with Disabilities Act.
  - 2. ICC's Uniform Construction Code.
  - 3. City and Local Codes.
  - 4. National Fire Protection Association (NFPA), i.e. National Electric Code - NFPA 70, Standard for Electrical Safety in the Workplace – NFPA 70E, and Life Safety Code - NFPA 101.
  - 5. Pennsylvania Department of Health
  - 6. National Electrical Safety Code - ANSI C2.
  - 7. Client Agency's insuring agency.
- B. Should any change in the drawings and/or specifications be required to conform to the codes, ordinances, regulations or laws mentioned above, the Architect shall be notified prior to the time of submitting bids. After signing of the Contract, each Contractor will be responsible for the

completion of all work necessary to meet the above mentioned requirements without additional expense to the Client Agency.

- C. The Contractor shall comply with all rules, regulations and recommendations of any public utility serving this project.
- D. The entire electrical system shall be installed in accordance with the latest edition of the National Electrical Code, approved by the governmental body having jurisdiction, including amendments thereto.

#### 1.10 FAMILIARITY WITH CONTRACT REQUIREMENTS

- A. The Electrical Contractor shall confer with all other Contractors and shall apply for detailed and specific information regarding the location of all equipment as the final location may differ from that indicated on the drawings. Outlets, equipment or wiring improperly placed because of the Electrical Contractor's failure to obtain this information shall be relocated and reinstalled by the Electrical Contractor without additional expense to the Client Agency.

#### 1.11 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Penetration Firestopping."
- E. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- F. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- G. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.
- H. Coordinate electrical work with that of other trades so that:

1. Interference between general construction, mechanical, electrical, structural and other specialty trades is avoided.
2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of electrical equipment.

- I. All electrical materials and equipment shall be kept as close as possible to ceiling, walls and columns to occupy the minimum amount of space.
- J. Furnish and install all offsets, fittings and similar items necessary to accomplish the requirements of coordination, without additional expense.

#### 1.12 COORDINATION DRAWINGS

- A. Refer to requirements in the General Conditions.

#### 1.13 RECORD DOCUMENTS

- A. Refer to requirements in the General Conditions.

#### 1.14 MAINTENANCE MANUALS

- A. Refer to requirements in the General Conditions.

#### 1.15 WARRANTY

- A. Refer to requirements in the General Conditions.

#### 1.16 CLEAN-UP

- A. Refer to requirements in the General Conditions.

#### 1.17 DELIVERY, STORAGE, AND HANDLING

- A. Refer to requirements in the General Conditions.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends or bonding bushings where required.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.
    - c. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Firestopping".

## 2.2 MISCELLANEOUS METAL

- A. The Contractor shall furnish all labor, materials, equipment, and services necessary for the installation of all miscellaneous metal work required to complete this Contract.
- B. All equipment and materials furnished and installed under this Contract, which are not mounted on bases or floors, shall be securely attached and supported from the main supporting structure of the building by metal hangers, clamps, and/or brackets. Metal hangers, clamps, and/or brackets shall be of suitable design and of sufficient strength to properly and safely support the equipment and materials involved.
- C. All supports, brackets, and clamps and other items specified herein shall be installed in strict accordance with the best practices of the trade and recognized code.
- D. Structural steel members required for the support of equipment installed under this Contract shall conform to ASTM Standard Specification A-36, and shall comply with the latest requirements of the American Institute of Steel Construction. Structural steel shall be of standard sections, as given in the structural steel manufacturer's handbooks.
- E. All steel and iron work shall be primed with Rust-Oleum No. X-60, or approved equal. Before priming, all metal shall be thoroughly cleaned free from scale, rust, and dirt.
- F. The Contractor shall provide all anchors, bolts, screws, dowels, and connecting members, and do all cutting and fitting necessary to secure the work to adjoining construction. Build in connecting members to masonry, concrete, and structural steel as the work progresses.
- G. The Contractor shall furnish 16 ounce sheet copper, clamps, waterproofing materials, labor, and whatever else necessary for the installation of weathertight flashings and waterproofing around all conduits or other equipment passing through roof or exterior walls. Baseplates shall not be less than 15" square. Bolts and clamps shall be brass. All flashings shall be installed in cooperation with the General Contractor.
- H. Supports and brackets shall be neatly constructed of structural shapes to adequately support the equipment intended. All supports must be approved prior to installation. Field conditions will regulate the type of support required.

## 2.3 PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

- C. All non-galvanized and unpainted iron and steel work installed in crawl spaces, accessible pipe spaces and above ceilings under this Contract shall be painted two coats of Rust-Oleum rust preventative paint. First coat shall be Rust-Oleum No. X-60 red primer and second coat shall be Rust-Oleum No. 634 black gloss. All galvanized and non-galvanized iron and steel work installed above roof and at other locations at the exterior of the building shall be painted similar to the above, except finish coats shall be of colors selected by the Architect. Galvanized surfaces shall be given a primer suitable for application.
- D. Engine generator exhaust piping at the exterior of the building shall be painted a heat resisting paint. Color shall be approved by the Architect prior to installation.

#### 2.4 ACCESS PANELS

- A. The Electrical Contractor shall furnish factory-fabricated access panels for access to all concealed receptacles, pull boxes, junction boxes, capped conduits and other electrical equipment where no other means of access is available. Access panels are not required at lift-out removable tile ceilings. Access panels shall be of appropriate size, but not less than 18" x 12" flush type, hinged to drop down and out, screwdriver operated, stainless steel in masonry and tile work and prime coated sheet steel in plaster or acoustical tile of all types. The Electrical Contractor shall deliver panels with all necessary supports to the General Contractor for installation.
- B. Access panels shall be suitable for the type of construction in which they are to be installed. Refer to architectural drawings and co-ordinate access panel types with the General Contractor.
- C. At locations where access panels are installed in fire-rated ceilings, access panels shall contain the 1-1/2 hour fire-rated "B" label; and in addition, shall also be provided with layers of gypsum wall board in a thickness which will supply an additional one hour fire rating.
- D. Exact locations and sizes shall be determined by the Electrical Contractor. Locations for access panels in finished spaces must be approved by the Architect. All panels shall be installed and located to present a neat and symmetrical appearance.
- E. Junction boxes, capped conduits and other electrical equipment above removable tile ceilings or above access panels shall be suitably identified by small inconspicuous adhesive-backed labels attached to the ceiling surface or the surface of the access panel. Labels shall be additionally secured with screws or rivets. Labels shall be white with 1/4" high black letters and shall be manufactured of engraved Micarta or Bakelite with pressure sensitive backing, and shall be colorfast. Identification label shall not exceed 2-1/2" in length and 3/4" in height, and shall be manufactured by the Seton Nameplate Company, Brady Co., Kimball Systems, or approved equal. Flexible plastic punched tapes will not be acceptable. Labels shall be coordinated with those being supplied under other contracts.
- F. Clearance Around Access Panels: Sufficient clear working space shall be provided and maintained around all access panels to permit safe and convenient operation and maintenance of concealed equipment. Equipment and appurtenances installed under this Contract shall be located in such a manner so as to provide and/or maintain an unobstructed and continuous clear working space in front of all access panels, including those installed under other Contracts. In all cases, the work space shall be adequate to permit at least 90-degree opening of doors or hinged panels. Therefore, this Contractor shall be responsible for relocating any equipment or appurtenances furnished and installed under this Contract where such items are obstructing access panels installed under other Contracts.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- F. Right of Way: Give to piping systems installed at a required slope.
- G. All penetrations and openings in slabs, walls, floors, etc. shall not be carried out until the area has been X-Rayed for structural steel, rebar, conduits, etc. Refer to X-Ray specification in the General Requirements.

### 3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Selection of Supports: Comply with manufacturer's written instructions.
- D. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

### 3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.4 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.5 PAINTING

- A. Refinish and touch up paint.
  - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
  - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
  - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
  - 5. Minimum touch up diameter shall be 2".

- B. The Electrical Contractor shall furnish all labor, materials, tools, and other equipment necessary for all painting hereinafter specified. Painting shall be accomplished by workmen skilled in this type of work.
- C. All exposed non-galvanized cabinets, supports and equipment installed in the Equipment Rooms under this Contract shall be painted one prime coat and two coats of best quality satin finished enamel paint, of colors selected by the Architect.
- D. The outside of all cabinets, control equipment, channels, supports, boxes, etc., installed in finished areas throughout the building, shall be painted one prime coat and two finish coats of best quality satin finished enamel paint of colors selected by the Architect. Galvanized conduits, boxes, supports, etc. above ceilings shall not be painted. In finished areas, all paints shall be low VOC.
- E. Where the factory finish on equipment such as lighting fixture trim, etc., has been damaged, the equipment shall be refinished to the satisfaction of the Architect.
- F. All painting shall be done in a careful, neat and workmanlike manner with particular care being exercised to protect building equipment and finishes. All surfaces shall be thoroughly cleaned of rust, scale, dirt, grease, dust, and like items, and sanded so as to provide bond for new paint. The Contractor shall be entirely responsible for cleaning all surfaces and should evidence appear to the Architect that the surface was not properly prepared, the Contractor shall remove paint, prepare surface, and repaint as required at no additional cost.
- G. Nameplates and data plates that indicate the manufacturer, model, size, capacity, codes or identifying data on equipment to be painted shall not be painted, but shall be carefully masked and left unpainted.
- H. All conduits, outlet boxes, junction boxes, pull boxes, etc., installed in conjunction with the Fire Alarm System shall be painted "RED" in color throughout the entire installation.

### 3.6 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor, ceiling and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."
- B. Unused slots, sleeves and other penetrations in floors, walls or other general construction shall be closed and sealed with an approved firestopping material.
  - 1. Firestopping material shall be UL listed.

### 3.7 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
  - 1. Supporting devices for electrical components.
  - 2. Sleeves
  - 3. Touchup painting.



### 3.8 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
- C. All construction waste is the responsibility of the Contractor and must be removed in accordance with Section 01745.

### 3.9 SCHEDULE OF WORK

- A. Refer to requirements in the General Conditions.

### 3.10 MAINTENANCE AND OPERATING MANUALS

- A. Refer to requirements in the General Conditions.

### 3.11 SIZING

- A. Capacity: Provide equipment and material of sizes, capacities, horsepower, power ratings and dimensions indicated on the drawings, in the schedules and as specified.
- B. Fit and Clearance: Equipment and material of greater or larger power, dimensions, capacity and ratings may be furnished provided such proposed equipment is approved in writing and feeders, circuit breakers, conduit, motors, structural supports, bases and equipment spaces are increased by the Contractor at no additional cost. All clearances shall comply with the requirements of Article 110 of the latest edition of the National Electrical Code.

### 3.12 COORDINATION OF WORK

- A. Coordinate electrical work with that of other trades so that:
  - 1. Interference between general construction, mechanical, electrical, structural and other specialty trades is avoided.
  - 2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of electrical equipment.
  - 3. Indicate aisleways and accessways required on coordinated shop drawings for boiler plants, mechanical equipment rooms, computer rooms, laboratories and kitchens.
  - 4. Provide shop drawings, drawn to a scale of 1/2 inch to the foot, showing all structural, mechanical, architectural and electrical equipment intended to be furnished. Any equipment conflicting with other equipment or space constrictions shall be indicated at the submittal stage.
- B. All electrical materials and equipment shall be kept as close as possible to ceiling, walls and columns to occupy the minimum amount of space.
- C. Furnish and install all offsets, fittings and similar items necessary to accomplish the requirements of coordination, without additional expense.

### 3.13 EQUIPMENT CLEARANCES

- A. All finished field installations shall reflect clearances which in the opinion of the Architect and/or applicable regulatory authorities are adequate for:
  - 1. The latest edition of the National Electrical Code.
  - 2. Life safety codes (local and state).
  - 3. Preventative maintenance.
  - 4. Routine maintenance.
  - 5. Breakdown repair.
  - 6. Parts removal and entrance.
  - 7. Machinery removal and access.

### 3.14 CERTIFICATION

- A. General: Provide Certification from an independent inspection agency, that the installation meets the latest edition of the NFPA 70. Provide a letter from each systems manufacturer verifying that all systems and equipment are installed and operating in accordance with the respective manufacturer's recommendations and as specified in the appropriate sections.

### 3.15 EQUIPMENT WIRING

- A. The Electrical Contractor shall provide electrical service to all equipment specified and/or shown on the drawings. The Contractor shall furnish and install all wiring, conduit, boxes, miscellaneous wiring materials, connections, and all required electrical material to provide a complete, operational system. All connections shall be made to conform to the manufacturer's diagrams and instructions.
- B. Manual motor switches, magnetic motor starters, disconnect switches and fuses required for the operation of equipment furnished under other contracts shall be provided under this Contract and shall be as hereinbefore specified.
- C. Exact roughing-in dimensions for equipment shall be obtained from the Contractor supplying the equipment, as the Electrical Contractor will be responsible for correct roughing-in and proper wiring of equipment.
- D. Certain equipment will be furnished complete with controls by the equipment supplier. Power wiring and 120 volt control wiring shall be furnished and installed by the Electrical Contractor.
- E. This Contractor shall furnish and install all power and 120 volt control wiring, conduit, boxes, final connections, etc., for all electrically operated equipment furnished under other Contracts. Disconnect switches and motor starting equipment shall be furnished and installed by the Electrical Contractor, unless the equipment is specified to be furnished with such devices.
- F. The Electrical Contractor shall provide fuses for each and every fusible device installed as part of this project. This shall include fusible devices installed under other divisions of work.
- G. The Contractor shall wire complete to all motors shown on the drawings leaving same in perfect operating condition. All final connections to motors and controllers shall be made under this Contract unless specified otherwise. The approximate motor characteristics are shown on the drawings; however, the Contractor shall check the exact characteristics and voltages of the motors before the installation of wiring or final connections.

- H. Branch feeders to motors not located adjacent to walls shall be run overhead and terminated adjacent to motor locations with outlet boxes placed 6" above finished floor. Short flexible conduit connections shall be used for connections to motors.
- I. Special control devices required for operation of equipment furnished under other contracts, except as hereinafter specified, will be furnished and delivered (by the Contractor furnishing the particular equipment) to the Electrical Contractor for installation and connections.
- J. Elevator controller, controls and control wiring will be furnished and installed under the Elevator Contract. The Electrical Contractor shall furnish and install all power wiring to the elevator controller as shown. The Electrical Contractor shall furnish and install a fused disconnect switch at the controller.
- K. All control circuits regardless of their locations shall be provided with a disconnecting means as required by the National Electrical Code. The disconnecting means shall be a switch or similar device arranged to disconnect all power leads to the control circuits.

END OF SECTION 260500

## SECTION 260519

### LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Copper building wire rated 600 V or less.
  - 2. Metal-clad cable, Type MC, rated 600 V or less.
  - 3. Connectors, splices, and terminations rated 600 V and less.

##### 1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.
- B. VFC: Variable-frequency controller.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer's authorized service representative.
- B. Field quality-control reports.

##### 1.6 QUALITY CONTROL

- A. Testing Agency Qualifications: Member company of NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## PART 2 - PRODUCTS

### 2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- D. Conductor Insulation:
  - 1. Type THHN and Type THWN-2: Comply with UL 83.
  - 2. Type XHHW-2: Comply with UL 44.

### 2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Comply with UL 1569.
  - 3. RoHS compliant.
  - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:
  - 1. Single circuit and multicircuit with color-coded conductors.
  - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Ground Conductor: Insulated.
- F. Conductor Insulation:
  - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
  - 2. Type XHHW-2: Comply with UL 44.

- G. Armor: Aluminum, interlocked.
- H. Jacket: PVC applied over armor.

### 2.3 ARMORED CABLE, TYPE AC

- A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in an overall metallic sheath.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Comply with UL 4.
  - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:
  - 1. Single circuit and multicircuit with color-coded conductors.
  - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Ground Conductor: Insulated.
- F. Conductor Insulation: Type THHN/THWN-2. Comply with UL 83.
- G. Armor: Aluminum, interlocked.

### 2.4 MINERAL-INSULATED CABLE, TYPE MI

- A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600 V or less.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. UL 2196 for fire resistance.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper.
- D. Insulation: Compressed magnesium oxide.
- E. Sheath: Copper.

## 2.5 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
  - 1. Material: Copper.
  - 2. Type: One or Two hole with standard or long barrels.
  - 3. Termination: Compression or Crimp.

## 2.6 2-HR FIRE RATED METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath., with a 2-hour fire rating
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Vitalink.
  - 2. Southwire, LLC
  - 3. Prysmian
  - 4. Or equal as approved by the Professional.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Comply with UL 1569.
  - 3. 2 hour fire rated per UL standard 2196 following ASTM E119 (1,850°F with water hose stream)
  - 4. Electrical Circuit Integrity Systems (FHIT) — System No. 120 of the UL Fire Resistance Directory
  - 5. Rated FT-4 / IEEE 1202 Vertical Flame test; -ST1, limited smoke
  - 6. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
  - 1. Single circuit and multicircuit with color-coded conductors.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Equipment grounding copper armor, terminated with commercially available brass MC connectors and the cable connections are made without the need for splicing or use of special tools..

- G. Conductor Insulation:
  - 1. LSZH Ceramifiable Silicone.
- H. Armor: Continuously welded and corrugated copper, interlocked.
- I. Jacket: Flame resistant low smoke zero halogen (colorable).
- J. Inner Jacket: Ceramifiable silicon rubber bedding layer

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- D. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- E. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway or Armored cable, Type AC or Metal-clad cable, Type MC.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- H. VFC Output Circuits: Type XHHW-2 in metal conduit.



### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 CONNECTIONS

- A. 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.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Using Agency will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. After installing conductors and cables and before electrical circuitry has been energized, test conductors feeding the following critical equipment and services for compliance with requirements:
    - a. Fire pump.
    - b. Stair pressurization fans.
  - 3. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression-applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements.

3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

## SECTION 260526

### GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Ground bonding common with lightning protection system.
  - 2. Foundation steel electrodes.
  - 3. Emergency power system grounding.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1) Grounding arrangements and connections for separately derived systems.

## 1.6 QUALITY CONTROL

- A. Testing Agency Qualifications: Certified by NETA.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### 2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

### 2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Conduit Hubs: Mechanical type, terminal with threaded hub.
- G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt or socket set screw.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- K. Straps: Solid copper, copper lugs. Rated for 600 A.
- L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

### 3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.

- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
  7. Armored and metal-clad cable runs.
  8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
  9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

### 3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- C. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install [tinned ]bonding jumper to bond across flexible duct connections to achieve continuity.

- E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
- G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Professional promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526



## SECTION 260529

### HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:

1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Nonmetallic slotted support systems.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
  - a. Slotted support systems, hardware, and accessories.
  - b. Clamps.
  - c. Hangers.
  - d. Sockets.
  - e. Eye nuts.
  - f. Fasteners.
  - g. Anchors.
  - h. Saddles.
  - i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
  2. Ductwork, piping, fittings, and supports.
  3. Structural members to which hangers and supports will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Items penetrating finished ceiling, including the following:
    - a. Luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Projectors.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional, as defined in Section 014000 "Quality Requirements," to design hanger and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame Rating: Class 1.
  2. Self-extinguishing according to ASTM D 635.

#### 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  2. Material for Channel, Fittings, and Accessories: Galvanized steel or Plain steel.
  3. Channel Width: Selected for applicable load criteria.
  4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
  - C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
  - D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
  - E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
    1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
    4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
    5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
    6. Toggle Bolts: Stainless-steel springhead type.
    7. Hanger Rods: Threaded steel.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  1. NECA 1.
  2. NECA 101
  3. NECA 102.
  4. NECA 105.
  5. NECA 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps or single-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  - 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

## SECTION 260533

### RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:

1. Metal conduits and fittings.
2. Metal wireways and auxiliary gutters.
3. Surface raceways.
4. Boxes, enclosures, and cabinets.

- B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
2. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

##### 1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional.
- C. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. GRC: Comply with ANSI C80.1 and UL 6.
3. ARC: Comply with ANSI C80.5 and UL 6A.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - a. Comply with NEMA RN 1.
  - b. Coating Thickness: 0.040 inch, minimum.
6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:
  - a. Material: Steel or die cast.
  - b. Type: Setscrew or compression.
6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Screw-cover type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

## 2.3 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Prime coated, ready for field painting.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- E. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- F. Gangable boxes are allowed.
- G. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.



## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: EMT.
  - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 6. Damp or Wet Locations: GRC.
  - 7. Boxes and Enclosures: NEMA 250, Type 1.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use setscrew or compression, steel or cast-metal fittings. Comply with NEMA FB 2.10.
  - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install surface raceways only where indicated on Drawings.

### 3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Do not fasten conduits onto the bottom side of a metal deck roof.

- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Complete raceway installation before starting conductor installation.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- H. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- I. Support conduit within 12 inches of enclosures to which attached.
- J. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Professional for each specific location.
  - 5. Change from ENT to GRC before rising above floor.
- K. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- L. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- M. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

- Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- R. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- S. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- T. Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
  2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- U. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- V. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service raceway enters a building or structure.
  3. Conduit extending from interior to exterior of building.
  4. Conduit extending into pressurized duct and equipment.
  5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  6. Where otherwise required by NFPA 70.
- W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- X. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Set metal floor boxes level and flush with finished floor surface.
- GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- 3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- 3.4 FIRESTOPPING
- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

## SECTION 260544

### SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

- B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### PART 2 - PRODUCTS

##### 2.1 SLEEVES

- A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- E. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Stainless steel.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.



### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

## SECTION 260553

### IDENTIFICATION FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For arc-flash hazard study.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.

- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E and Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 3. Colors for 240-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
  - 4. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
  - 5. Color for Neutral: White or gray.
  - 6. Color for Equipment Grounds: Green.
- C. Warning Label Colors:
  - 1. Identify system voltage with black letters on an orange background.

- D. Warning labels and signs shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- E. Equipment Identification Labels:
  - 1. Black letters on a white field.

## 2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
  - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  - 2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
  - 1. Minimum Nominal Size:
    - a. 1-1/2 by 6 inches for raceway and conductors.
    - b. 3-1/2 by 5 inches for equipment.
    - c. As required by authorities having jurisdiction.

## 2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

## 2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

## 2.6 SIGNS

- A. Laminated Acrylic or Melamine Plastic Signs:
  - 1. Engraved legend.
  - 2. Thickness:
    - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
    - b. For signs larger than 20 sq. in., 1/8 inch thick.
    - c. Engraved legend with black letters on white face.
    - d. Self-adhesive.
    - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.7 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F.
  - 5. Color: Black.

## 2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### 3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer or load shedding.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
- M. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Labels:
  - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

- W. Nonmetallic Preprinted Tags:
  - 1. Place in a location with high visibility and accessibility.
  - 2. Secure using general-purpose cable ties.
- X. Laminated Acrylic or Melamine Plastic Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.
- Y. Cable Ties: General purpose, for attaching tags, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels or vinyl tape applied in bands.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels or self-adhesive wraparound labels or snap-around labels or snap-around color-coding bands or self-adhesive vinyl tape to identify the phase.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Auxiliary Electrical Systems Conductor Identification: Marker tape or Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.



1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- G. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- H. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
1. Apply to exterior of door, cover, or other access.
  2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
- J. Arc Flash Warning Labeling: Self-adhesive labels.
- K. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- L. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer or load shedding.
- M. Equipment Identification Labels:
1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
  2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchgear.
    - e. Switchboards.
    - f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - g. Emergency system boxes and enclosures.
    - h. Motor-control centers.
    - i. Enclosed switches.
    - j. Enclosed circuit breakers.
    - k. Enclosed controllers.
    - l. Variable-speed controllers.
    - m. Power-transfer equipment.
    - n. Battery racks.

- o. Power-generating units.
- p. Monitoring and control equipment.

END OF SECTION 260553

## SECTION 260572

### OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

##### 1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
  - 1. Short-circuit study input data, including completed computer program input data sheets.
  - 2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional.
    - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Professional for preliminary submittal of

sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

- b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Short-Circuit Study Software Developer, Short-Circuit Study Specialist and Field Adjusting Agency.
- B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

## 1.6 QUALITY CONTROL

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. The computer program shall be developed under the charge of a licensed professional who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Short-Circuit Study Specialist Qualifications: Professional in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional.
- D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 COMPUTER SOFTWARE

- A. Comply with IEEE 399 and IEEE 551.
- B. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

## 2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Cable size and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Comments and recommendations for system improvements, where needed.
- E. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
  - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
  - 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
  - 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.
- G. Short-Circuit Study Output:
  - 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. Equivalent impedance.
  - 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. Calculated asymmetrical fault currents:
      - 1) Based on fault-point X/R ratio.
      - 2) Based on calculated symmetrical value multiplied by 1.6.
      - 3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. No AC Decrement (NACD) ratio.
  - e. Equivalent impedance.
  - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
  - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Obtain all data necessary for the conduct of the study.
  1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Professional.
  2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
  3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
- B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the Professional in charge of performing the study, and shall be by the Professional or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
  1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  2. Obtain electrical power utility impedance at the service.
  3. Power sources and ties.
  4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
  6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
  7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
  9. Motor horsepower and NEMA MG 1 code letter designation.
  10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

### 3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
  - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
  - 2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
  - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
  - 1. Electric utility's supply termination point.
  - 2. Incoming switchgear.
  - 3. Unit substation primary and secondary terminals.
  - 4. Low-voltage switchgear.
  - 5. Motor-control centers.
  - 6. Control panels.
  - 7. Standby generators and automatic transfer switches.
  - 8. Branch circuit panelboards.
  - 9. Disconnect switches.

### 3.3 ADJUSTING

- A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 DEMONSTRATION

- A. Train Using Agency's operating and maintenance personnel in the use of study results.

END OF SECTION 260572



## SECTION 260573

### OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
  - 1. Study results shall be used to determine coordination of series-rated devices.

##### 1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
  - 1. Coordination-study input data, including completed computer program input data sheets.
  - 2. Study and equipment evaluation reports.
  - 3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional.

- a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Professional for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Coordination Study Software Developer, Coordination Study Specialist and Field Adjusting Agency.
- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. The following parts from the Protective Device Coordination Study Report:
      - 1) One-line diagram.
      - 2) Protective device coordination study.
      - 3) Time-current coordination curves.
    - b. Power system data.

#### 1.7 QUALITY CONTROL

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. The computer program shall be developed under the charge of a licensed professional who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Coordination Study Specialist Qualifications: Professional in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional.
- D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing

laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Software Developers:
- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
  - 1. Optional Features:
    - a. Arcing faults.
    - b. Simultaneous faults.
    - c. Explicit negative sequence.
    - d. Mutual coupling in zero sequence.

### 2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Cable size and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
  - a. Phase and Ground Relays:
    - 1) Device tag.
    - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
    - 3) Recommendations on improved relaying systems, if applicable.
  - b. Circuit Breakers:
    - 1) Adjustable pickups and time delays (long time, short time, ground).
    - 2) Adjustable time-current characteristic.
    - 3) Adjustable instantaneous pickup.
    - 4) Recommendations on improved trip systems, if applicable.
  - c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:
  - a. Power utility's overcurrent protective device.
  - b. Medium-voltage equipment overcurrent relays.
  - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
  - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
  - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
  - f. Cables and conductors damage curves.
  - g. Ground-fault protective devices.
  - h. Motor-starting characteristics and motor damage points.
  - i. Generator short-circuit decrement curve and generator damage point.
  - j. The largest feeder circuit breaker in each motor-control center and panelboard.
5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity

- is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.
6. Provide adequate time margins between device characteristics such that selective operation is achieved.
  7. Comments and recommendations for system improvements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
  1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

### 3.2 PROTECTIVE DEVICE COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. The study shall be based on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
  1. To normal system low-voltage load buses where fault current is 10 kA or less.
  2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Transformer Primary Overcurrent Protective Devices:
  1. Device shall not operate in response to the following:
    - a. Inrush current when first energized.
    - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
  2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

- H. Motor Protection:
  - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
  - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.
- K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
  - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
  - 1. Electric utility's supply termination point.
  - 2. Switchgear.
  - 3. Unit substation primary and secondary terminals.
  - 4. Low-voltage switchgear.
  - 5. Motor-control centers.
  - 6. Standby generators and automatic transfer switches.
  - 7. Branch circuit panelboards.
- M. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
  - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
  - 3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

### 3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the overcurrent protective device study.
  - 1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Professional.
  - 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
  - 3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and

engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

- B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the Professional in charge of performing the study, and shall be by the Professional or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  2. Electrical power utility impedance at the service.
  3. Power sources and ties.
  4. Short-circuit current at each system bus, three phase and line-to-ground.
  5. Full-load current of all loads.
  6. Voltage level at each bus.
  7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
  9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
  10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
  12. Maximum demands from service meters.
  13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
  14. Motor horsepower and NEMA MG 1 code letter designation.
  15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
  16. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.
  17. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
    - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    - d. Generator thermal-damage curve.
    - e. Ratings, types, and settings of utility company's overcurrent protective devices.
    - f. Special overcurrent protective device settings or types stipulated by utility company.
    - g. Time-current-characteristic curves of devices indicated to be coordinated.
    - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
- k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

#### 3.4 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

#### 3.5 DEMONSTRATION

- A. Engage the Coordination Study Specialist to train Using Agency's maintenance personnel in the following:
  - 1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
  - 2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
  - 3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573



## SECTION 260574

### OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

##### 1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
  - 1. Arc-flash study input data, including completed computer program input data sheets.
  - 2. Arc-flash study report; signed, dated, and sealed by a qualified professional.
    - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Professional for preliminary submittal of

sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Arc-Flash Study Software Developer, Arc-Flash Study Specialist and Field Adjusting Agency.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
  - 1. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
  - 2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Using Agency's personnel that comply with requirements in NFPA 70E.

#### 1.7 QUALITY CONTROL

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. The computer program shall be developed under the charge of a licensed professional who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Arc-Flash Study Specialist Qualifications: Professional in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional.
- D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Comply with IEEE 1584 and NFPA 70E.
- B. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

### 2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Cable size and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
- F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."
- G. Arc-Flash Study Output:
  - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. No AC Decrement (NACD) ratio.
    - e. Equivalent impedance.
    - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:
  - 1. Arcing fault magnitude.
  - 2. Protective device clearing time.

3. Duration of arc.
  4. Arc-flash boundary.
  5. Working distance.
  6. Incident energy.
  7. Hazard risk category.
  8. Recommendations for arc-flash energy reduction.
- I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

### 2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
1. Location designation.
  2. Nominal voltage.
  3. Flash protection boundary.
  4. Hazard risk category.
  5. Incident energy.
  6. Working distance.
  7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

### 3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies:
1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
  2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

- C. Calculate maximum and minimum contributions of fault-current size.
  - 1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
  - 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
  - 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
  - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
  - 1. When the circuit breaker is in a separate enclosure.
  - 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

### 3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
  - 1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of Professional.
  - 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
  - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the Professional in charge of performing the study, and shall be by the Professional or its

representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

### 3.4 LABELING

- A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
  1. Motor-control center.
  2. Low-voltage switchboard.
  3. Switchgear.
  4. Medium-voltage switch.
  5. Control panel.

### 3.5 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 DEMONSTRATION

- A. Engage the Arc-Flash Study Specialist to train Using Agency's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

## SECTION 260800

### ELECTRICAL SYSTEMS COMMISSIONING

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The Specifications Sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 ADDITIONAL RELATED DOCUMENTS

- A. Related Sections
  - 1. Section 019100 - Commissioning Requirements.

##### 1.3 DESCRIPTION

- A. The Electrical Systems related to the Boiler Plant to be commissioned are as follows:
  - 1. Electrical Power Distribution Systems.
  - 2. Lighting and Control Systems.
  - 3. Fire Alarm Systems.
  - 4. Security, Alarm and Detection Systems.
  - 5. Communication Systems.

#### PART 2 - PRODUCTS

##### 2.1 TEST EQUIPMENT

- A. The .4 Contractor shall provide all equipment necessary to fulfill the testing requirements of Division 26.

#### PART 3 - EXECUTION

##### 3.1 RESPONSIBILITIES

- A. .4 Contractor. The commissioning responsibilities applicable to the .4 Contractor are as follows:  
Construction and Acceptance Phase
  - 1. Attend the initial commissioning meeting conducted at the start of construction, the commissioning meeting held 30 days prior to startup of the primary equipment, and all commissioning team meetings.



2. Provide one copy of approved shop drawings and startup reports for all commissioned equipment to the CA. Supplement the shop drawing data with the manufacturer's installation and start-up procedures. This material should be identical to the literature, which will be included in the Operation and Maintenance Manuals.
3. The Operation and Maintenance Manuals shall be submitted to the CA prior to the start of training (3 weeks before start-up and training and at least 60 days before substantial completion).
4. During the startup and initial checkout process, execute all portions of the manufacturer's start-up checklists, for all commissioned electrical equipment.
5. Perform and clearly document all completed startup, pre-functional checklists and system operational checkout procedures, providing a copy to the CA.
6. The CA writes, coordinates, witnesses and conducts functional performance test procedures. Contractors for each trade shall provide the necessary support to the CA to complete functional testing.
7. Address current A/E punch list items and Commissioning corrective action items before functional and/or acceptance testing.
8. Provide skilled technicians to execute starting of equipment and to perform tests in accordance with all Division 26 sections. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
9. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and A/E and retest the equipment.
10. Provide training of the Client Agency's operating staff using expert qualified personnel, as specified.
11. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

#### Warranty Period

12. Correct deficiencies and make necessary adjustments to O&M manuals for applicable issues identified in any seasonal testing.

### 3.2 SUBMITTALS

- A. Copies of electrical shop drawings will be provided to CxA, when they are submitted to the Professional, electronically through E-Builder. CxA will review shop drawings concurrently with the Professional and provide any comments to the Professional so they may be included in their comments. Copies of approved shop drawings and startup reports for all commissioned equipment will be forwarded to the CxA through E-Builder. Supplement the shop drawing data with the manufacturer's installation and start-up procedures. This material should be identical to the literature which will be included in the Operation and Maintenance Manuals.
- B. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the Professional will approve them.

### 3.3 STARTUP

- A. The .4 Contractor shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section. Equipment start-up is required to complete systems and sub-systems so they are fully functional, in compliance with the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Client Agency.
- B. Testing is intended to begin upon completion of a system.

3.4 TESTS

- A. Refer to applicable Division 26 sections for a description of the process, specific details, and/or standards referenced for acceptance testing.

3.5 WRITTEN WORK PRODUCTS

- A. Written work products of .4 Contractor will consist of the filled out start-up, initial checkout, pre-functional checklists, and test documentation in accordance with all Division 26 sections.

END OF SECTION 260800

## SECTION 262213

### LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
  - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
  - 3. Include diagrams for power, signal, and control wiring.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Source quality-control reports.
- C. Field quality-control reports.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

## 1.6 QUALITY CONTROL

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
  - 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain each transformer type from single source from single manufacturer.

### 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Comply with NFPA 70.
  - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Transformers Rated 15 kVA and Larger:
  - 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
  - 2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

### 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70.

- B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
  - 1. One leg per phase.
  - 2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
  - 3. Grounded to enclosure.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Coil Material: Aluminum.
  - 2. Internal Coil Connections: Brazed or pressure type.
  - 3. Terminal Connections: Bolted.
- D. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.
- E. Enclosure: Ventilated.
  - 1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound using a vacuum-pressure impregnation process to seal out moisture and air.
  - 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
  - 3. Wiring Compartment: Sized for conduit entry and wiring installation.
  - 4. Finish: Comply with NEMA 250.
    - a. Finish Color: Gray weather-resistant enamel.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- I. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- J. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.
- K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
  - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor, without exceeding the indicated insulation class in a 40 deg C maximum ambient and a 24-hour average ambient of 30 deg C.
  - 2. Indicate value of K-factor on transformer nameplate.
  - 3. Unit shall comply with requirements of DOE 2016 efficiency levels when tested according to NEMA TP 2 with a K-factor equal to one.
- L. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
  2. Include special terminal for grounding the shield.
- M. Neutral: Rated 200 percent of full load current for K-factor-rated transformers.
- N. Wall Brackets: Wall brackets fabricated from design drawings signed and sealed by a licensed structural engineer.
- O. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
1. 9.00 kVA and Less: 40 dBA.
  2. 9.01 to 30.00 kVA: 45 dBA.
  3. 30.01 to 50.00 kVA: 45 dBA for K-factors of 1, 4, and 9.

## 2.4 IDENTIFICATION

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

## 2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
  2. Ratio tests at rated voltage connections and at all tap connections.
  3. Phase relation and polarity tests at rated voltage connections.
  4. No load losses, and excitation current and rated voltage at rated voltage connections.
  5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
  6. Applied and induced tensile tests.
  7. Regulation and efficiency at rated load and voltage.
  8. Insulation-Resistance Tests:
    - a. High-voltage to ground.
    - b. Low-voltage to ground.
    - c. High-voltage to low-voltage.
  9. Temperature tests.
- B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
  - 2. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" or Section 033053 "Miscellaneous Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
  - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Secure transformer to concrete base according to manufacturer's written instructions.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

### 3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- C. 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.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Using Agency will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
  - 1. Visual and Mechanical Inspection.
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, and grounding.
    - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    - d. Verify the unit is clean.
    - e. Perform specific inspections and mechanical tests recommended by manufacturer.
    - f. Verify that as-left tap connections are as specified.
    - g. Verify the presence of surge arresters and that their ratings are as specified.
  - 2. Electrical Tests:
    - a. Measure resistance at each winding, tap, and bolted connection.
    - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
    - c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
    - d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- F. Large (Larger Than 167-kVA Single Phase or 500-kVA Three Phase) Dry-Type Transformer Field Tests:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, and grounding.



- c. Verify that resilient mounts are free and that any shipping brackets have been removed.
- d. Verify the unit is clean.
- e. Perform specific inspections and mechanical tests recommended by manufacturer.
- f. Verify that as-left tap connections are as specified.
- g. Verify the presence of surge arresters and that their ratings are as specified.

2. Electrical Tests:

- a. Measure resistance at each winding, tap, and bolted connection.
- b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
- c. Perform power-factor or dissipation-factor tests on all windings.
- d. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
- e. Perform an excitation-current test on each phase.
- f. Perform an applied voltage test on all high- and low-voltage windings to ground. See IEEE C57.12.91, Sections 10.2 and 10.9.
- g. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

G. Remove and replace units that do not pass tests or inspections and retest as specified above.

H. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

- 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
- 2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
- 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

I. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

## SECTION 262416

### PANELBOARDS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.
  - 3. Load centers.
  - 4. Electronic-grade panelboards.

##### 1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Keys: Two spares for each type of panelboard cabinet lock.
  2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
  3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

## 1.8 QUALITY CONTROL

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

## 1.10 FIELD CONDITIONS

- A. Environmental Limitations:

- 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
  - b. Altitude: Not exceeding 6600 feet.

- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

- 1. Ambient temperatures within limits specified.
- 2. Altitude not exceeding 6600 feet.

- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Using Agency or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

- 1. Notify Professional no fewer than two days in advance of proposed interruption of electric service.
- 2. Do not proceed with interruption of electric service without Professional's written permission.
- 3. Comply with NFPA 70E.

## 1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

- 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Height: 84 inches maximum.
  - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
  - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
  - 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  - 6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  - 7. Finishes:
    - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
    - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- G. Incoming Mains:
  - 1. Location: Convertible between top and bottom.
  - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- H. Phase, Neutral, and Ground Buses:
  - 1. Material: Tin-plated aluminum.
    - a. Plating shall run entire length of bus.

- b. Bus shall be fully rated the entire length.
  - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
  - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  - 4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
- 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
  - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  - 4. Main and Neutral Lugs: Compression or Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
  - 5. Ground Lugs and Bus-Configured Terminators: Compression or Mechanical type, with a lug on the bar for each pole in the panelboard.
  - 6. Feed-Through Lugs: Compression or Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - 7. Subfeed (Double) Lugs: Compression or Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  - 8. Gutter-Tap Lugs: Compression or Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
- J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- 1. Percentage of Future Space Capacity: Five percent.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
- 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  - 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

## 2.2 POWER PANELBOARDS

- A. Panelboards: NEMA PB 1, distribution type.

- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- C. Mains: As indicated.
- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers or Bolt-on circuit breakers.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- F. Branch Overcurrent Protective Devices: Fused switches.

### 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: [Circuit breaker] [or] [lugs only].
- C. Branch Overcurrent Protective Devices: Plug-in or Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

### 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    - f. Integral test jack for connection to portable test set or laptop computer.



- g. Field-Adjustable Settings:
  - 1) Instantaneous trip.
  - 2) Long- and short-time pickup levels.
  - 3) Long and short time adjustments.
  - 4) Ground-fault pickup level, time delay, and I squared T response.
- 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
- 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
- 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
- 8. Subfeed Circuit Breakers: Vertically mounted.
- 9. MCCB Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Breaker handle indicates tripped status.
  - c. UL listed for reverse connection without restrictive line or load ratings.
  - d. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
  - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
  - f. Ground-Fault Protection: [Integrally mounted] [Remote-mounted] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - g. Shunt Trip: [120-V] [24-V] <Insert voltage> trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage.
  - h. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
  - i. Auxiliary Contacts: One, SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
  - j. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
  - k. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  - l. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
  - m. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
  - n. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
  - o. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

## 2.5 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder or metal frame with transparent protective cover.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

## 2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.

- D. Equipment Mounting:
  - 1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
  - 3. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
- J. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- L. Install filler plates in unused spaces.
- M. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- O. Mount spare fuse cabinet in accessible location.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Using Agency's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- D. Tests and Inspections:
  - 1. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Professional of effect on phase color coding.
  - 1. Measure loads during period of normal facility operations.
  - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Professional. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
  - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

### 3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

## SECTION 262726

### WIRING DEVICES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:

1. Straight-blade convenience.
2. GFCI receptacles.
3. Toggle switches.
4. Wall switch sensor light switches with dual technology sensors.
5. Wall switch sensor light switches with passive infrared sensors.
6. Wall switch sensor light switches with ultrasonic sensors.
7. Wall-box dimmers.
8. Wall plates.

##### 1.3 DEFINITIONS

- A. Abbreviations of Manufacturers' Names:

1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

- B. BAS: Building automation system.

- C. EMI: Electromagnetic interference.

- D. GFCI: Ground-fault circuit interrupter.

- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

- F. RFI: Radio-frequency interference.

- G. SPD: Surge protective device.

- H. UTP: Unshielded twisted pair.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

### PART 2 - PRODUCTS

#### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with the requirements in this Section.
- D. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

#### 2.2 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

#### 2.3 GFCI RECEPTACLES

- A. General Description:
  - 1. 125 V, 20 A, straight blade, feed-through type.
  - 2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.

3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Tamper-Resistant, Duplex GFCI Convenience Receptacles:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

## 2.4 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole:

- a. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2. Two Pole:

- a. <Double click here to find, evaluate, and insert list of manufacturers and products.>

3. Three Way:

- a. <Double click here to find, evaluate, and insert list of manufacturers and products.>

4. Four Way:

- a. <Double click here to find, evaluate, and insert list of manufacturers and products.>

## 2.5 WALL SWITCH SENSOR LIGHT SWITCH, DUAL TECHNOLOGY

A. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual technology.

1. Connections: Provisions for connection to BAS.
2. Connections: Hard wired.
3. Connections: Wireless.
4. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 hp at 120-V ac.
5. Integral relay for connection to BAS.
6. Adjustable time delay of 20 minutes.
7. Able to be locked to Manual-On mode.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
9. Comply with NEMA WD 1, UL 20, and FS W-S-896.



## 2.6 WALL SWITCH SENSOR LIGHT SWITCH, PASSIVE INFRARED

- A. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using passive infrared technology.
1. Connections: Provisions for connection to BAS.
  2. Connections: Hard wired.
  3. Connections: Wireless.
  4. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 hp at 120-V ac.
  5. Integral relay for connection to BAS.
  6. Adjustable time delay of 20 minutes.
  7. Able to be locked to Manual-On mode.
  8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
  9. Comply with NEMA WD 1, UL 20, and FS W-S-896.

## 2.7 WALL SWITCH SENSOR LIGHT SWITCH, ULTRASONIC

- A. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using ultrasonic technology.
1. Connections: Provisions for connection to BAS.
  2. Connections: Hard wired.
  3. Connections: Wireless.
  4. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 hp at 120-V ac.
  5. Integral relay for connection to BAS.
  6. Adjustable time delay of 20 minutes.
  7. Able to be locked to Manual-On mode.
  8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
  9. Comply with NEMA WD 1, UL 20, and FS W-S-896.

## 2.8 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
  3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
  4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, thermoplastic with lockable cover.

## 2.9 FINISHES

### A. Device Color:

1. Wiring Devices Connected to Normal Power System: Almond unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

### B. Wall Plate Color: For plastic covers, match device color.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

#### B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

#### C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

#### D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

### 3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
  2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.
  4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  5. Using the test plug, verify that the device and its outlet box are securely mounted.
  6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 262726

## SECTION 262813

### FUSES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in enclosed switches panelboards switchboards enclosed controllers and motor-control centers.
2. Spare-fuse cabinets.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
  - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
  - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

##### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

#### 1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

#### 1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Bussmann, Inc.
  - 2. Edison Fuse, Inc.
  - 3. Ferraz Shawmut, Inc.
  - 4. Littelfuse, Inc.

#### 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

#### 2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
  1. Feeders with an ampacity 600A and greater: Class L, time delay.
  2. Motor Branch Circuits: Class RK1, time delay.
  3. Other Branch Circuits: Class RK1, time delay.

### 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) as directed by the architect.

### 3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

## SECTION 262816

### ENCLOSED SWITCHES AND CIRCUIT BREAKERS

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Nonfusible switches.
  - 2. Molded-case circuit breakers (MCCBs).
  - 3. Molded-case switches.
  - 4. Enclosures.

##### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.



- B. Shop Drawings: For enclosed switches and circuit breakers.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include wiring diagrams for power, signal, and control wiring.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
    - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

#### 1.7 QUALITY CONTROL

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

#### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet.

## 1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

### 2.2 NONFUSIBLE SWITCHES

- A. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.
  4. Service-Rated Switches: Labeled for use as service equipment.

### 2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over

center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

- C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker.
- D. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Lugs shall be suitable for 140 deg F rated wire on 125-A circuit breakers and below.
- F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and I-squared t response.
- J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- L. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- M. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- N. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Mechanical or Compression type, suitable for number, size, trip ratings, and conductor material.
  - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - 4. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

## 2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.
- F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

## 2.5 ELEVATOR SHUNT-TRIP FUSED DISCONNECT

- A. Provide shunt-trip fused disconnect switch with all necessary relay(s), control transformer and other options, as shown on drawings and listed below:
  - 1. Short-circuit current rating of 200,000A fuses.
  - 2. Interlocks to prevent the opening of the cover when the switch is in the ON position. Interlock shall be defeatable for testing purposes.
  - 3. Handle lockable in OFF position.
  - 4. 100VA control power transformer with primary and secondary fuses. The primary voltage rating shall be 480 volts with a 120V secondary.
  - 5. Isolation relay (3PDT, 10amp, 120V). The coil of the isolation relay shall be 120V AC. A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid (140VA inrush at 120V).
  - 6. Provide additional options as indicated below:
    - a. Key to Test Switch.
    - b. "On" Pilot Light - Green.
    - c. Isolated Full Capacity Neutral Lug.
    - d. 1P NC Mechanical Interlock (required for hydraulic elevators with automatic recall).
    - e. Fire Alarm Voltage Monitoring Relay (Comply with NFPA 72).
    - f. NEMA 1 Enclosure.
    - g. Entire assembly (including shunt-trip switch, control wiring and accessories) shall have a short-circuit rating of 200,000A.
    - h. Provide 100 ampere rated at 480 volts.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

### 3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Using Agency or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Professional no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.

### 3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.
  - 3. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

### 3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

### 3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Using Agency will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
    - f. Verify that each fuse has adequate mechanical support and contact integrity.
    - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      - 1) Use a low-resistance ohmmeter.
        - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
        - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
    - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
    - i. Verify correct phase barrier installation.
    - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

F. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
  - 1) Use a low-resistance ohmmeter.
    - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:
  - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
  - e. Determine the following by primary current injection:
    - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
  - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
  - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
  - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
  - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and



- circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
      - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
      - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- G. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- H. Prepare test and inspection reports.
- 1. Test procedures used.
  - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
  - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

### 3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

END OF SECTION 262816

SECTION 263600  
TRANSFER SWITCHES

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section includes automatic transfer switches rated 600 V and less, including the following:
  - 1. Bypass/isolation switches.
  - 2. Remote annunciator system.
  - 3. Remote annunciator and control system.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
  - 2. Include material lists for each switch specified.
  - 3. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
  - 4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer-authorized service representative and testing agency.
- B. Seismic Qualification Data: Certificates, for transfer switches, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - a. Features and operating sequences, both automatic and manual.
  - b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

#### 1.6 QUALITY CONTROL

A. Testing Agency Qualifications:

1. Member company of NETA.
  - a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

#### 1.7 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Using Agency or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify Professional no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Professional's written permission.

#### 1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 12 months from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.
- F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
  - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
  - 2. Short-time withstand capability for three cycles.
- H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- K. Service-Rated Transfer Switch:
  - 1. Comply with UL 869A and UL 489.
  - 2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
  - 3. In systems with a neutral, the bonding connection shall be on the neutral bus.
  - 4. Provide removable link for temporary separation of the service and load grounded conductors.
  - 5. Surge Protective Device: Service rated.
  - 6. Ground-Fault Protection: Comply with UL 1008 for [normal bus] [normal and alternative buses].
  - 7. Service Disconnecting Means: Externally operated, manual [mechanically] [electrically] actuated.

- L. Neutral Switching: Where four-pole switches are indicated, provide overlapping neutral contacts.
- M. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- N. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.
- O. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- P. Battery Charger: For generator starting batteries.
  - 1. Float type, rated 10 A.
  - 2. Ammeter to display charging current.
  - 3. Fused ac inputs and dc outputs.
- Q. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- R. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable [with printed] [tape] [shrinkable sleeve] markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
  - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
  - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
  - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
  - 4. Accessible via front access.
- S. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

## 2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cummins Power Generation.
  - 2. Eaton.
  - 3. Emerson.
  - 4. GE Zenith Controls.
  - 5. General Electric Company.
  - 6. Hubbell Power Systems, Inc.
  - 7. Kohler Power Systems.
  - 8. Or equal as approved by the Professional.
- B. Comply with Level 1 equipment according to NFPA 110.
- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
  2. Switch Action: Double throw; mechanically held in both directions.
  3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
  4. Conductor Connectors: Suitable for use with conductor material and sizes.
  5. Material: Hard-drawn copper, 98 percent conductivity.
  6. Main and Neutral Lugs: Compression or Mechanical type.
  7. Ground Lugs and Bus-Configured Terminators: Compression or Mechanical type.
  8. Ground bar.
  9. Connectors shall be marked for conductor size and type according to UL 1008.
- D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- E. Automatic Closed-Transition Transfer Switches: Connect both sources to load momentarily. Transition is controlled by programming in the automatic transfer-switch controller.
1. Fully automatic make-before-break operation when transferring between two available power sources.
  2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
  3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
    - a. Initiation occurs without active control of generator.
    - b. Automatic transfer-switch controller takes active control of generator to match frequency, phase angle, and voltage.
    - c. Controls ensure that closed-transition load transfer closure occurs only when the two sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
  4. Failure of power source serving load initiates automatic break-before-make transfer.
- F. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- G. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- H. Electric Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- I. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- J. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

K. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
  - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
  - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
  - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
  - b. Push-button programming control with digital display of settings.
  - c. Integral battery operation of time switch when normal control power is unavailable.

L. Large-Motor-Load Power Transfer:

1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if

- both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.
  3. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

## 2.3 TRANSFER SWITCH ACCESSORIES

### A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 1 equipment according to NFPA 110.
3. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
  - a. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. Interlocks shall prevent transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.
  - b. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.
  - c. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.
  - d. Transition: Provide closed-transition operation when transferring from main transfer switch to bypass/isolation switch on the same power source.
  - e. Transition: Provide open-transition operation when transferring between power sources.
  - f. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
  - g. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
  - h. Manual Control: Constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations in 15 seconds or less. Operating handles shall be externally operated.
  - i. Automatic and Nonautomatic Control: Automatic transfer-switch controller shall also control the bypass/isolation switch.
  - j. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
  - k. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.



4. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

B. Remote Annunciator System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
3. Annunciation panel display shall include the following indicators:
  - a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
  - b. Switch position.
  - c. Switch in test mode.
  - d. Failure of communication link.
4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
  - a. Indicating Lights: Grouped for each transfer switch monitored.
  - b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
  - c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
  - d. Lamp Test: Push-to-test or lamp-test switch on front panel.

C. Remote Annunciator and Control System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Include the following functions for indicated transfer switches:
  - a. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
  - b. Indication of switch position.
  - c. Indication of switch in test mode.
  - d. Indication of failure of digital communication link.
  - e. Key-switch or user-code access to control functions of panel.
  - f. Control of switch-test initiation.
  - g. Control of switch operation in either direction.
  - h. Control of time-delay bypass for transfer to normal source.
3. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically shall revert to standalone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
4. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
  - a. Controls and indicating lights grouped together for each transfer switch.
  - b. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
  - c. Digital Communication Capability: Matched to that of transfer switches supervised.
  - d. Mounting: Flush, modular, steel cabinet unless otherwise indicated.

## 2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
  - 1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
    - a. Overvoltage.
    - b. Undervoltage.
    - c. Loss of supply voltage.
    - d. Reduction of supply voltage.
    - e. Alternative supply voltage or frequency is at minimum acceptable values.
    - f. Temperature rise.
    - g. Dielectric voltage-withstand; before and after short-circuit test.
    - h. Overload.
    - i. Contact opening.
    - j. Endurance.
    - k. Short circuit.
    - l. Short-time current capability.
    - m. Receptacle withstand capability.
    - n. Insulating base and supports damage.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
  - 1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
  - 3. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
  - 4. Provide workspace and clearances required by NFPA 70.
- B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- C. Identify components according to Section 260553 "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

### 3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, motor controls, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Using Agency if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
  - 1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Connect twisted pair cable according to Section 260523 "Control-Voltage Electrical Power Cables."
- G. Connect twisted pair cable according to Section 271513 "Communications Copper Horizontal Cabling."
- H. Route and brace conductors according to manufacturer's written instructions and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.
- I. Brace and support equipment according to Section 260548.16 "Seismic Controls for Electrical Systems."
- J. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. After installing equipment, test for compliance with requirements according to NETA ATS.
  - 2. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with Drawings and Specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, grounding, and required clearances.

- d. Verify that the unit is clean.
- e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
- f. Verify that manual transfer warnings are attached and visible.
- g. Verify tightness of all control connections.
- h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
  - 1) Use of low-resistance ohmmeter.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
- i. Perform manual transfer operation.
- j. Verify positive mechanical interlocking between normal and alternate sources.
- k. Perform visual and mechanical inspection of surge arresters.
- l. Inspect control power transformers.
  - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
  - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
  - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

### 3. Electrical Tests:

- a. Perform insulation-resistance tests on all control wiring with respect to ground.
- b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
- c. Verify settings and operation of control devices.
- d. Calibrate and set all relays and timers.
- e. Verify phase rotation, phasing, and synchronized operation.
- f. Perform automatic transfer tests.
- g. Verify correct operation and timing of the following functions:
  - 1) Normal source voltage-sensing and frequency-sensing relays.
  - 2) Engine start sequence.
  - 3) Time delay on transfer.
  - 4) Alternative source voltage-sensing and frequency-sensing relays.
  - 5) Automatic transfer operation.
  - 6) Interlocks and limit switch function.
  - 7) Time delay and retransfer on normal power restoration.
  - 8) Engine cool-down and shutdown feature.

### 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

- a. Check for electrical continuity of circuits and for short circuits.
- b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
- c. Verify that manual transfer warnings are properly placed.
- d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
    - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
    - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    - c. Verify time-delay settings.
    - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
    - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
  6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
    - a. Verify grounding connections and locations and ratings of sensors.
- D. Coordinate tests with tests of generator and run them concurrently.
- E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- F. Transfer switches will be considered defective if they do not pass tests and inspections.
- G. Remove and replace malfunctioning units and retest as specified above.
- H. Prepare test and inspection reports.
- I. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
  1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

### 3.4 DEMONSTRATION

- A. Train Using Agency's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 265119  
LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section includes the following types of LED luminaires:

- 1. Cylinder.
- 2. Downlight.
- 3. Linear industrial.
- 4. Lowbay.
- 5. Parking garage.
- 6. Recessed linear.
- 7. Strip light.
- 8. Surface mount, linear.
- 9. Surface mount, nonlinear.
- 10. Suspended, linear.
- 11. Suspended, nonlinear.
- 12. Materials.
- 13. Finishes.
- 14. Luminaire support.

- B. Related Requirements:

- 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.

- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests.

- a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

- B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

- D. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and/or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
  - a. Other luminaires.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.
  - f. Ceiling-mounted projectors.

7. Moldings.

- E. Qualification Data: For testing laboratory providing photometric data for luminaires.



- F. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- G. Product Certificates: For each type of luminaire.
- H. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- I. Sample warranty.
- J. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### 1.5 QUALITY CONTROL

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
  - 1. Obtain Professional's approval of luminaires in mockups before starting installations.
  - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Professional specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

#### 1.7 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE 7.

### 2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Standards:

- 1. ENERGY STAR certified.
- 2. California Title 24 compliant.
- 3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- 4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- 5. UL Listing: Listed for damp location.
- 6. Recessed luminaires shall comply with NEMA LE 4.
- 7. User Replaceable Lamps:
  - a. Bulb shape complying with ANSI C78.79.
  - b. Lamp base complying with ANSI C81.61.

- C. CRI of minimum 70. CCT of 3000 K.

- D. Rated lamp life of 50,000 hours to L70.

- E. Lamps dimmable from 100 percent to 0 percent of maximum light output.

- F. Internal driver.

- G. Nominal Operating Voltage: 120 V ac.

- 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

### 2.3 MATERIALS

- A. Metal Parts:

- 1. Free of burrs and sharp corners and edges.
- 2. Sheet metal components shall be steel unless otherwise indicated.
- 3. Form and support to prevent warping and sagging.

- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

- C. Diffusers and Globes:
  - 1. Prismatic acrylic.
  - 2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 3. Glass: Annealed crystal glass unless otherwise indicated.
  - 4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
  
- D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage, and coating.
    - c. CCT and CRI for all luminaires.

## 2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## 2.5 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## 2.6 LIGHTING FIXTURE SCHEDULE

- A. Refer to Electrical Drawings for Lighting Fixture Schedule.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 TEMPORARY LIGHTING

- A. If approved by the Professional, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

### 3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.
  - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  3. Adjust the aim of luminaires in the presence of the Professional.

END OF SECTION 265119

## SECTION 265219

### EMERGENCY AND EXIT LIGHTING

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Exit signs.

##### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire" Paragraph.
- D. Lumen: Measured output of lamp and luminaire, or both.
- E. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
  - 1. Include data on features, accessories, and finishes.
  - 2. Include physical description of the unit and dimensions.
  - 3. Battery and charger for light units.
  - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
  - 5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
    - a. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
    - b. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

- B. Shop Drawings: For nonstandard or custom luminaires.
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each product and for each color and texture specified.
- D. Samples for Initial Selection: For each type of luminaire with factory-applied finishes.
- E. Samples for Verification: For each type of luminaire.
  - 1. Include Samples of luminaires and accessories to verify finish selection.
- F. Product Schedule:
  - 1. For emergency lighting units. Use same designations indicated on Drawings.
  - 2. For exit signs. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.
- B. Product Certificates: For each type of luminaire.
- C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Sample Warranty: For manufacturer's warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

2. Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

## 1.8 QUALITY CONTROL

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

## 1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Two year(s) from date of Substantial Completion.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for [first year and prorated warranty for the remaining four years] [the entire warranty period].

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.



- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for fluorescent luminaires.
- F. Lamp Base: Comply with ANSI C81.61.
- G. Bulb Shape: Complying with ANSI C79.1.
- H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
  - 1. Emergency Connection: Operate one lamp(s) continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
  - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
    - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
    - c. Humidity: More than 95 percent (condensing).
    - d. Altitude: Exceeding 3300 feet.
  - 4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 5. Battery: Sealed, maintenance-free, nickel-cadmium type.
  - 6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  - 7. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  - 8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- I. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.

1. Emergency Connection: Operate one LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type.
6. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.
7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
9. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
10. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.2 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Lighting Unit:
  1. Emergency Lighting Unit: As indicated on drawings.

## 2.3 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  1. Operating at nominal voltage as indicated on drawings.
  2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.

## 2.4 MATERIALS

- A. Metal Parts:
  1. Free of burrs and sharp corners and edges.
  2. Sheet metal components shall be steel unless otherwise indicated.
  3. Form and support to prevent warping and sagging.

- B. Doors, Frames, and Other Internal Access:
  - 1. Smooth operating, free of light leakage under operating conditions.
  - 2. Designed to permit relamping without use of tools.
  - 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
  - 1. Prismatic acrylic.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
  - 1. [Extruded aluminum] <Insert type> housing[ and heat sink].
  - 2. Powder coat finish.
- E. Conduit: Electrical metallic tubing, minimum 3/4 inch in diameter.

## 2.5 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position when testing emergency power unit.
  - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
  - 1. Attached to a minimum 20-gage backing plate attached to wall structural members.
  - 2. Do not attach luminaires directly to gypsum board.
- F. Suspended Luminaire Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod and wire support for suspension for each unit length of luminaire chassis, including one at each end.
  - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Ceiling Grid Mounted Luminaires:
  - 1. Secure to any required outlet box.
  - 2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
  - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

### 3.5 STARTUP SERVICE

- A. Perform startup service:
  - 1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.

### 3.6 ADJUSTING

- A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:
  - 1. Inspect all luminaires. Replace lamps, emergency power units, batteries, or luminaires that are defective.
    - a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265219

## SECTION 281500

### INTEGRATED ACCESS CONTROL HARDWARE DEVICES

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. This sections includes an expansion of the existing continental card access system which includes:
  - 1. Integrated credential readers and entry management.
  - 2. Access control credentials.
  - 3. Electrified locking devices and accessories.
  - 4. Egress management devices.
  - 5. Access control remote devices.
  - 6. Electronic key management systems.

##### 1.3 DEFINITIONS

- A. NFC: Near Field Communications.

##### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Coordination Meeting(s): For integrated access control hardware devices. Conduct meeting(s) at Project site.
  - 1. Attendees: Installers, fabricators, representatives of manufacturers, representatives from telecommunications, Client Agency, Department, and administrants for field tests and inspections. Notify Architect, Department, and Client Agency of scheduled meeting dates.

##### 1.5 ACTION SUBMITTALS

- A. Product Data:
  - 1. Integrated Credential Readers and Entry Management:
    - a. Credential readers.
    - b. Keypads.
    - c. Combination reader devices.

2. Access Control Credentials:
  - a. Access control cards.
3. Electrified Locking Devices and Accessories:
  - a. Electrically controlled single-point locks and latches.
  - b. Electrically controlled two- and three-point locks and latches.
  - c. High-security electronic locks.
  - d. Status monitoring and egress devices.
4. Egress Management Devices:
  - a. Panic hardware with special locking arrangement.
  - b. Fire-exit hardware with special locking arrangement.
5. Access Control Remote Devices:
  - a. NFC access control devices.
6. Electronic Key Management Systems:
  - a. Electronic key management system units.

B. Shop Drawings:

1. Project general notes.
2. Device layout.
3. Block diagram and cable/conduit routing.
4. System communications details.
5. System mounting details.
6. Secondary power calculations.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

## 1.6 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation[ and testing] instructions issued to Installer by manufacturer for the following:

1. Installation instructions for integrated credential readers and entry management devices.
2. Manufacturer's recommended tests and inspections for integrated credential readers and entry management devices.
3. Printing, programming, and handling instructions for access control credentials.
4. Installation instructions for electrified locking devices and accessories.
5. Manufacturer's recommended tests and inspections for electrified locking devices and accessories.
6. Installation instructions for egress management devices.
7. Manufacturer's recommended tests and inspections for egress management devices.
8. Installation instructions for access control remote devices.
9. Manufacturer's recommended tests and inspections for access control remote devices.

10. Installation instructions for electronic key management systems.
11. Manufacturer's recommended tests and inspections for electronic key management systems.

B. Sample warranties.

#### 1.7 CLOSEOUT SUBMITTALS

A. Maintenance Contracts:

1. Software and firmware service agreements.

B. Warranty documentation.

#### 1.8 WARRANTY

A. Integrated Credential Readers and Entry Management Devices Warranty:

1. Special Installer Extended Warranty: Installer warrants that fabricated and installed integrated credential readers and entry management devices perform in accordance with specified requirements and agrees to repair or replace components that fail to perform as specified within extended-warranty period.

- a. Extended-Warranty Period: Five years from date of Substantial Completion; full coverage for labor, materials, and equipment.

### PART 2 - PRODUCTS

#### 2.1 INTEGRATED CREDENTIAL READERS AND ENTRY MANAGEMENT

A. Swipe Card Reader E3.04: Compatible with the existing system.

B. Manufacturer: Subject to compliance with requirements, provide components manufactured by Acre Security (formerly Open Options).

1. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.7, Substitution of Materials, of the General Conditions to the Construction contract does not apply to the above item.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:

1. Cable Type: Shielded as per manufacturer's recommendations.
2. Digital Maximum Cable Length: 300 ft.



- C. Interfaces with Other Work:
  - 1. Coordinate installation of new products for access control hardware devices with existing conditions.
  - 2. Coordinate access control credentials with integrated credential readers and access control system architecture.

### 3.2 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by the Department and Client Agency.
- B. Tests and Inspections:
  - 1. Perform manufacturer's recommended tests and inspections.
- C. Manufacturer Services:
  - 1. Engage factory-authorized service representative to support field tests and inspections.

### 3.3 MAINTENANCE

- A. Software and Firmware Service Agreement:
  - 1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software and firmware support for two years.
  - 2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software and firmware upgrades that become available within two years from date of Substantial Completion. Verify that upgrading software includes operating system and new or revised licenses for using software.
    - a. Upgrade Notice: No fewer than 30 days to allow the Department to schedule and access the system and to upgrade computer equipment if necessary.
  - 3. Upgrade Reports: Prepare report after each update, documenting upgrades installed.

END OF SECTION 281500

## SECTION 281603

### SECURITY SYSTEM UPGRADE

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section Includes:

1. Upgrade of the existing security system as required to achieve the specified system performance requirements.
2. The work of this Section shall be performed as delegated design.

##### 1.3 SUBMITTALS

- A. Product Data: Components for systems integration and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

1. Functional Block Diagram: Field survey all existing wiring and provide a single-line interconnections between components including interconnections between components. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify programmable logic controllers, networks and control interface devices and media to be used. Describe characteristics of network and other data communication lines.
  - a. Indicate methods used to achieve systems integration.
  - b. Indicate control, signal, and data communication paths and identify PLCs, networks, control interface devices, and media to be used.
  - c. Describe characteristics of network and other data communication lines.
  - d. Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.
2. Battery: Sizing calculations.
3. Device Address List: Coordinate with final system programming.
4. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
5. Details of surge-protection devices and their installation.

- C. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.
- D. Qualification Data: For delegated designer installer and security systems integrator.
- E. Field quality-control reports.
- F. Warranty: Sample of special warranty.
- G. Other Information Submittals:
  - 1. Test Plan and Schedule: Test plan defining all tests required to ensure that system meets technical, operational, and performance specifications.
  - 2. Examination reports documenting inspections of substrates, areas, and conditions.
- H. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. Include the following:
  - 1. Data for each type of product, including features and operating sequences, both automatic and manual.
  - 2. Master control-unit hardware and software data.

#### 1.4 QUALITY CONTROL

- A. Delegated Designer Qualifications:
  - 1. Security systems designer who is trained and approved for installation of equipment required for this project.
- B. Installer Qualifications:
  - 1. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.
  - 2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- C. Intrusion Detection Systems Integrator Qualifications: An experienced intrusion detection equipment supplier and Installer who has completed systems integration work for installations similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. FM Global Compliance: FM-Approved and -labeled intrusion detection devices and equipment.
- F. Comply with NFPA 70.

## 1.5 DELEGATED DESIGN SCOPE OF WORK

- A. The existing security system at the State Museum and PHMC Tower (former Archives) consists of the following security inputs (refer to Schedule at the end of this Section):
1. Door position switches.
  2. Break glass detectors.
  3. Motion detectors.
  4. Infrared sensors.
- B. There are 7 existing security data gathering panels/PLC/power supply locations, RP-A through RP-G. Refer to drawings. The security panels on the fourth floor of the Museum, were recently upgrades (in 2018) and are not part of the scope.
- C. Survey existing system and confirm input cables for existing inputs per the Schedule at the end of this Section.
- D. Advise the Professional, via and RFI in eBuilder, of any abandoned and/or unused cables. Remove all abandoned and/or unused cables. *Note that any fire alarm system components currently in the security panel enclosures will be removed under the fire alarm system upgrade portion of this project.*
- E. Remove all security system components, circuit boards, PLCs, power supplies, enclosures, etc.
- F. Manufacturer: Subject to compliance with requirements, provide components manufactured by Acre Security (formerly Open Options).
1. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.7, Substitution of Materials, of the General Conditions to the Construction contract does not apply to the above item.
- G. The Client Agency recently upgraded the door controls (card readers) and security detection devices on the 4<sup>th</sup> floor to an Open Options Access Technology (now Acre Security) platform. It is the intent of this security upgrade to remove all of the other existing data gathering panels, PLCs, etc. and upgrade them with new Open Options Access Technology compatible equipment.
- H. Currently alarms report to the Museum Command Center G-18 and the Capitol Police at the IMCS located at the East Wing via the COWPA Network.
1. It is the intent of the Client Agency that during normal hours of operation of the Museum, alarms report to Command Center G-18. After hours the alarms should report to the Capitol Police IMCS.
  2. The current system does not permit the segregation of the alarm reporting based on the time of day.
  3. The upgraded system shall be programmable with regard to the time of day for alarm reporting to Command Center G-18 or Capitol Police IMCS.
- I. Design and select new replacement system components from the specified manufacturer as required to meet the Client Agency's intent for the upgraded security system. Components not specifically manufactured by the specified manufacturer, such as power supplies and enclosure cabinets, shall be compatible with the overall system.
- J. Where feasible by existing cable lengths, move cable pass-thrus from enclosure cabinets containing electronic equipment and provide new separate enclosure cabinets.
- K. The existing PC workstation and monitors at Command Center G-18 shall remain.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Description: Hard-wired, modular, microprocessor-based controls, using the existing intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
- B. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
  - 1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.
  - 2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.
  - 3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or control unit.
- C. System Control: The existing Master control unit shall directly monitor intrusion detection units and connecting wiring.
- D. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.
- E. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.
- F. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.
- G. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.
- H. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

## 2.2 SYSTEM COMPONENT REQUIREMENTS

- A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
  - 1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
  - 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.
- B. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.
- C. Tamper Protection: Tamper switches on detection devices, control units, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Master control-unit alarm display shall identify tamper alarms and indicate locations.
- D. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to master control unit.
- E. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to master control unit as an alarm signal.
- F. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to master control unit.
- G. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at master control unit for calibration, sensitivity, and alarm condition.

## 2.3 ENCLOSURES

- A. Interior Electronics: NEMA 250, Type 12.
  - 1. Provide hinged or lift-off enclosure covers with a keyed lock.
    - a. Key all enclosure locks the same.
  - 2. Provide tamper switches inside each enclosure to send an alarm when the enclosure is opened.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SYSTEM INSTALLATION

- A. Comply with UL 681 and NFPA 731.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
  - 1. At each location, provide labels on all wiring and a directory corresponding to the detection points per the Schedule at the end of this Section.
- C. Connecting to Existing Equipment: Verify that existing security system detector units are operational before making changes or connections.
  - 1. Connect new equipment to existing wiring.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.

### 3.4 GROUNDING

- A. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

### 3.5 FIELD QUALITY CONTROL

- A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.
- B. Testing Agency: Engage a qualified testing agency or qualified personnel of the installer to perform tests and inspections.
- C. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."
  1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
  2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."
- D. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."
- E. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

### 3.6 DEMONSTRATION

- A. Engage a manufacturer-authorized service representative to train Client Agency's security and maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training" for Department's requirements for video tape training.

END OF SECTION 281603



## EXISTING SECURITY PANEL SCHEDULES

### PANEL RP-G

1-81 SECURITY PANEL\COMMAND CENTER  
1-10 MUS GND POWER SUPPLY\COMMAND CENTER

### PANEL RP-F

2-10 MUS GND AUDITORIUM AUX PWR SUPPLY\IN CLOSET ON STAGE LEFT  
2-9 PANEL 2 SECURITY ALERT\ IN CLOSET STAGE LEFT AUDITORIUM\ACU

### PANEL RP-E

3-10 AUXILARY POWER SUPPLY BATTERIES\ ROOM G15 INSIDE G31 GND FLR MUSEUM

### PANEL RP-D

4-11 MUS RM 202 AUX POWER SUPPLY\ MUSEUM ROOM 202 ELEC RM

### PANEL RP-C

5-11 AUXILARY POWER SUPPLY BATTERIES\ GM ARCHIVES

### PANEL RP-B

6-11 ARCHIVES 3RD FL AUX PWR TRBLE\ 3RD FLOOR ON WALL BY AIR HANDLER

### PANEL RP-A

7-13 AUXILARY POWER SUPPLY BATTERIES\ 14TH FLR ARCHIVES BACK WALL

### PANEL RP-G INPUTS

1-02 DISPATCH GUARD TO FIRE PANEL  
1-09 PANEL 1 SEC ALERT  
1-10 MUS GND CMD CTR POWERSUPPLY  
1-17 MUSEUM 5 FLOOR STAIR 3 (EMERGENCY DOOR)  
1-18 MUSEUM 4 FLOOR STAIR 3 (EMERGENCY DOOR)  
1-19 MUSEUM 4 FL STAIR 3 MOTION DET  
1-20 MUSEUM 3 FLOOR STAIR 3 (EMERGENCY DOOR)  
1-21 MUSEUM 2 FLOOR STAIR 3 (EMERGENCY DOOR)  
1-22 MUSEUM 2 FL STAIR 3 MOTION DET  
1-23 MUSEUM 1 FLOOR STAIR 3 (EMERGENCY DOOR)  
1-24 MUSEUM GND FL STAIR 3 (EMERGENCY DOOR)  
1-27 MUSEUM EMG GEN ROOM DOOR (LOCATED IN PARKING GARAGE AREA)  
1-28 MUSEUM DOCUMENT RECIEVING DOORS (ROLLUP DOOR)  
1-29 MUSEUM LOADING DOCK DOOR  
1-49 PYROTRONICS PANEL ALARM FIRE  
1-50 PYROTRONICS PANEL FIRE TROUBLE  
1-81 SECURITY PNL TAMPER COMANDCNTR

### PANEL RP-G LINKS

1-1 PANEL 1 TO CAPITOL POLICE  
PROG NO:2 DISPATCH GUARD TO FIRE PANEL FIRE !!!!!  
1-3 FIRE PANEL TROUBLE CHECK PANEL REPAIR  
Prog No: 4 FIRE ALARM PANEL IN ALARM  
PROG NO: 5 WILLAM PENN BIBLE

### PANEL RP-F INPUTS

2-09 PANEL 2 SECURITY ALERT  
2-10 MUS GND AUDITORIUM AUX POWER SUPPLY  
2-17 MUSEUM GND BACKSTAGE FIRE EXIT / AT TOP OF BACK HALL TO OUTSIDE  
2-18 MUSEUM 4 FL STAIR 6 DOORS (EMERGENCY DOOR)  
2-19 MUSEUM 5 FL STAIR 6 DOORS (EMERGENCY DOOR)  
2-20 MUSEUM 3 FLOOR STAIR 6 DOOR (EMERGENCY DOOR)  
2-21 MUSEUM 2 FL STAIR 6 DOORS (EMERGENCY DOOR)  
2-22 MUSEUM 2ND FL STAIR 6 MOTION  
2-23 MUSEUM 1 FL STAIR 6 DOORS (EMERGENCY DOOR)  
2-24 MUSEUM GND FL STAIR 6 DOORS  
2-25 MUSEUM GND FL STAIR 4 DOORS (TO THE BASEMENT)  
2-26 AUDITORIUM STAGE EXIT DOORS / TO GARAGE  
2-27 MUSEUM GND FL MECH SPACE DOORS (ROLLUP IN GARAGE)  
2-28 MUSEUM RESTAURANT EXIT DOORS  
2-81 SECURITY PNL AUDITORUM TAMPER

### PANEL RP-F LINKS

2-1 PANEL 2 TO CAPITOL POLICE

### PANEL RP-3 INPUTS

3-9 PANEL 3 SEC ALERT  
3-10 MUSEUM GND ELEC RM POWERSUPPLY AUXILLARY  
3-17 MUSEUM GND GIFT SHOP ABOVE OFFICE G.B.  
3-20 MUSEUM GND FLOOR N PICTURE  
3-26 MUSEUM GND MAIN LOBBY G.B

### PANEL RP-E WIRELESS TRANSMITTER RECEIVING POINTS

3-27 n/a MUSEUM FINE ARTS C GALLERY  
3-28 n/a MUSEM FINE ARTS C GALLERY  
3-29 n/a MUSEUM FINE ARTS C GALLERY  
3-30 n/a GND FLOOR FINE ARTS S PIC  
3-31 n/a MUSEUM GROUND FLOOR S PICTURE  
3-32 n/a MUSEUM GROUND FLOOR S PICTURE  
3-33 n/a MUSEUM GROUND FLOOR S PICTURE  
3-34 n/a MUSEUM GROUND FLOOR S PICTURE  
3-35 GND FL CURIOSITY CORNER GLASS BREAK  
3-36 n/a MUSEUM FINE ARTS B GALLERY  
3-37 n/a MUSEUM GROUND FLOOR S PICTURE  
3-38 N/A MUSEUM FINE ARTS B GALLERY  
3-39 n/a MUSEUM FINE ARTS B GALLERY  
3-40 n/a MUSEUM FINE ARTS B GALLERY  
3-41 N/A MUSEUM FINE ARTS B GALLERY  
3-42 n/a WIRELESS TRANSMITTER  
3-43 n/a GND WIRELESS TRANSMITTER  
3-46 MUSEUM GROUND FLOOR N WORK ROOM (DOOR CONTACTS GIFT SHOP STORAGE RM)  
3-47 MUSEUM GND FL S WORK RM DOOR (G031/G016)  
3-51 GND FL N VESTIBULE GLASS B  
3-53 GND FL S VESTIBLE GLASS B  
3-57 MUSEUM GND CURIOSITY CORNER G.B.  
3-58 MUSEUM GND MAIN ENTRANCE GLASS BR / BY FRONT WINDOW  
3-59 MUSEUM GND GB MAIN ENTRANCE BOAT AREA / BY CANNON  
3-60 MUSEUM GND GIFT SHOP G.B.  
3-61 GND STUDENT ORIENTATION G.B. ( SUSQUEHANNA ROOM )  
3-62 FRONT DESK PANIC - SEND HELP !!!  
3-81 SECURITY ALERT PANEL GND FL ELEC

PANEL RP-E RELAYS

RELAY 3-3 GENERAL SECURITY ALARM TO CAPITOL  
RELAY 3-5 BIBLE TO CAPITOL

PANEL RP-E LINKS

PROG NO: 1 WILLIAM PENN BIBLE TO CAPITOL  
PROG NO: 3-2 FRONT DIALER GENERAL SECURITY

PANEL RP-D INPUTS

4-9 PANEL 4 SEC ALERT  
4- 10 MUS 2ND FL CIVIL WAR DISP CASE  
4- 11 MUS RM 202 AUX POWERSUPPLY MONITOR  
4- 17 MUSEUM 4 FLOOR REFRIGERATOR DOOR  
4- 20 3 FL SCIENCE @ ECOLOGY GLASS BREAKS (IN THE CEILING)

Birds of forest edge and Squirrel family

Forest and Escalator doors

Brook trout and caddisfly larvel case

Marsh and muskrat

Lake pond

4- 21 3 FL MAMMALS GLASS BREAK

Sensor between Fox's

Sensor between Bobcat and Beaver

4- 22 MUSEUM 3 FL Dino LAB GLASS BREAK (Nature Lab)

4- 23 2 FL INDIAN VILLAGE INFARED DET (5 Displays)

4- 24 2 FL PAINTING GLASS BREAK

4- 25 2 FLOOR ANTHROPOLOGY GLASS BREAK

Sensor above glass display above 1000BC-7000BC archaic period

Culture area of North America

Sensor above 800AD-1600AD Late woodland period

4- 27 1 FL VILLAGE SQUARE INFARED DETECTORS

Kitchen Infrared detector

Wood shop Infrared detector

Copper shop Infrared detector

4- 28 1 FL PLAZA EXIT GLASS BREAK (ABOVE DROP CEILING)

4- 29 1 FL N SHOW WINDOW GLASS BREAK (BEHIND WOODEN PANELS)

4- 30 1ST FL S SHOW WINDOW GLASSBREAK (BEHIND WOODEN PANELS)

4- 31 2nd FL. WILLIAM PENN BIBLE

4- 32 1 FL KIT DOORS (ACROSS FROM ELEVATOR)

4- 81 SECURITY ALERT PNL RM 202

PANEL RP-D LINKS

Prog No: 1 2ND FLR WILLIAM PENN BIBLE CASE ACTV  
4-2 PANEL 4 TO CAPITOL POLICE

PANEL RP-C INPUTS

5- 9 ARCHIVES GND FL W COURT S G.B.

Office A-20

Office A-21

Office A-22

Office A-23

Office A-24

Office A-25

Office A-26

Office A-27

5- 10 PANEL 5 SECURITY ALERT

5- 11 ARCHIVES GM AUX POWERSUPPLY TROUBLE (GM ARCHIVES)

5- 17 MEZZANINE FLOOR STAIR 1 DOOR

5- 18 ARCHIVE MEZZ

5- 19 ARCHIVES MEZZ FL STAIR 2 DOOR

5- 20 ARCHIVES MEZZ STREET FL STAIR 2

5- 21 GROUND FLOOR W.COURT DOOR NORTH / DOOR CONTACT

5- 22 GROUND FLOOR W.COURT DOOR SOUTH / DOOR CONTACT

5- 24 GND FL SEARCH RM GLASS BREAK (Reading Room Lobby)

5-28 GND HALLWAY VAULT DOOR

5-29 GND HALLWAY VAULT MOTION D.

5- 30 ARCHIVES GND EAST COURT DOOR

5- 32 GND FL W COURT N GLASS BREAKS

Break room A-1

Office A-2

Office A-3

Office A-4

Office A-5

Office A-6

Conference Room A-7

GND FL E COURT S GLASS BREAKS

Micro film room Sensor 1

Micro film room Sensor 2

Work room A-11 Sensor 1

Work room A-11 Sensor 2

Work room A-11 Sensor 3

Room A-12A Sensor 1

Room A-12A Sensor 2

Rome A-12-B Sensor 1

Rome A-12-C Sensor 1

Room A-15 Muster role room Sensor 1

Room A-15 Muster role room Sensor 2

5- 81 SECURITY ALERT PNL GM ARCHIVES TAMPER

PANEL RP-C LINKS

5-1 PANEL 5 TO CAPITOL

PANEL RP-B INPUTS

- 6- 9 PANEL 6 SECURITY ALT
- 6- 11 ARCHIVES 3RD FLOOR AUX POWER TROUBLE / BEHIND AIR HANDLER
- 6- 17 ARCHIVES 9 FLOOR STAIR 1 DOOR
- 6- 18 ARCHIVES 8 FLOOR STAIR 1 DOOR
- 6- 19 ARCHIVES 7 FLOOR STAIR 1 DOOR
- 6- 20 ARCHIVES 6 FLOOR STAIR 1 DOOR
- 6- 21 ARCHIVES 5 FLOOR STAIR 1 DOOR
- 6- 22 ARCHIVES 4 FLOOR STAIR 1 DOOR
- 6- 23 ARCHIVES 3 FLOOR VAULT ALARM
- 6- 24 ARCHIVES 2 FLOOR STAIR 1 DOOR
- 6- 25 ARCHIVES 1 FLOOR STAIR 1 DOOR
- 6- 26 ARCHIVES 9 FLOOR STAIR 2 DOOR
- 6- 27 ARCHIVES 8 FLOOR STAIR 2 DOOR
- 6- 28 ARCHIVES 7 FLOOR STAIR 2 DOOR
- 6- 29 ARCHIVES 6 FLOOR STAIR 2 DOOR
- 6- 30 ARCHIVES 5TH STAIR 2 DOOR
- 6- 31 ARCHIVES 4 FLOOR STAIR 2 DOOR
- 6- 32 ARCHIVES 3 FLOOR GENERAL ALARM
- 6- 33 ARCHIVES 2ND FLOOR STAIR 2
- 6- 34 ARCHIVES 1ST FLOOR STAIR 2
- 6- 81 SECURITY ALERT PNL 3 FL ARCHIVES / TAMPER BEHIND AIR HANDLER

PANEL RP-B LINKS

- 6-1 PANEL 6 TO CAPITOL

PANEL RP-A INPUTS

- 7- 10 ARCHIVES 10 FLOOR STAIR 2 DOOR
- 7- 11 PANEL 7 SEC ALERT
- 7- 13 ARCHIVES 14TH FLOOR POWER SUPPLY TROUBLE
- 7-15 ARCHIVES 10TH FLOOR STAIR 2
- 7- 16 ARCHIVES 11 FLOOR STAIR 2 DOOR
- 7- 17 ARCHIVES 18 FLOOR STAIR 1 DOOR
- 7- 18 ARCHIVES 17 FLOOR STAIR 1 DOOR
- 7- 19 ARCHIVES 16 FLOOR STAIR 1 DOOR
- 7- 20 ARCHIVES 15 FLOOR STAIR 1 DOOR
- 7- 21 ARCHIVES 14 FLOOR STAIR 1 DOOR
- 7- 22 ARCHIVES 13 FLOOR STAIR 1 DOOR
- 7- 23 ARCHIVES 12 FLOOR STAIR 1 DOOR
- 7- 24 ARCHIVES 11 FLOOR STAIR 1 DOOR
- 7- 25 ARCHIVES 10 FLOOR STAIR 1 DOOR
- 7- 26 ARCHIVES 18 FLOOR STAIR 2 DOOR
- 7- 27 ARCHIVES 17 FLOOR STAIR 2 DOOR
- 7- 28 ARCHIVES 16 FLOOR STAIR 2 DOOR
- 7- 29 ARCHIVES 15 FLOOR STAIR 2 DOOR
- 7- 30 ARCHIVES 14 FLOOR STAIR 2 DOOR
- 7- 31 ARCHIVES 13 FLOOR STAIR 2 DOOR
- 7- 32 ARCHIVES 12 FLOOR STAIR 2 DOOR
- 7- 81 SECURITY ALERT PNL 14TH FL \ TAMPER

PANEL RP-A LINKS

PROG NO: 1 ARCHIVES ELEVATOR RECALL  
7- 2 PANEL 7 TO CAPITOL  
MISCELLANEOUS SECURITY EQUIPMENT  
18TH FL ARCHIVES WATER BUG SYSTEM  
7- 12 WATER ALERT ARCHIVES 18TH FLOOR  
WATERBUG SENSOR 1  
WATERBUG SENSOR 2  
WATERBUG SENSOR 3  
WATERBUG SENSOR 4  
WATERBUG SENSOR 5

2ND FL ARCHIVES WATER BUG SYSTEM  
6-10 PANEL WATER ALERT ARCHIVES 2ND FLOOR  
WATERBUG SENSOR 1  
WATERBUG SENSOR 2  
WATERBUG SENSOR 3  
WATERBUG SENSOR 4

SECTION 282000  
VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section includes expansion of the existing continental security system, a video surveillance system consisting of cameras, data transmission wiring, and a control station with its associated equipment.

- B. RELATED SECTIONS

- 1. Section 0282301 Video Surveillance Head End. Upgrade for removal of the current Bosch video management system and replacement with two (2) Cognyte (Formerly Verint) video management system.

1.3 DEFINITIONS

- A. AGC: Automatic gain control.
- B. BNC: Bayonet Neill-Concelman - type of connector.
- C. B/W: Black and white.
- D. CCD: Charge-coupled device.
- E. FTP: File transfer protocol.
- F. IP: Internet protocol.
- G. LAN: Local area network.
- H. MPEG: Moving picture experts group.
- I. NTSC: National Television System Committee.
- J. PC: Personal computer.
- K. PTZ: Pan-tilt-zoom.
- L. RAID: Redundant array of independent disks.

- M. TCP: Transmission control protocol - connects hosts on the Internet.
- N. UPS: Uninterruptible power supply.
- O. WAN: Wide area network.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
  - 3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
  - 4. Wiring Diagrams: For power, signal, and control wiring.
- C. Design Data: Include an equipment list consisting of every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM REQUIREMENTS

- A. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.



1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NECA 1.
- D. Comply with NFPA 70.
- E. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

## 2.3 STANDARD CAMERAS

- A. Manufacturers: Subject to compliance with requirements. Provide cameras which are compatible with the Cognyte video management system by one of the following:
  1. Axis Communicators
  2. Bosch
  3. Hanwha Security
  4. Pelco
- B. Color Camera:
  1. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.
  2. With AGC, manually selectable on or off.

## 2.4 POWER SUPPLIES

- A. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera and lens.
  1. Enclosure: NEMA 250, Type 1.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN, WAN, and IP network before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 WIRING

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical."
- B. Wiring Method: Install cables in raceways unless otherwise indicated.
  - 1. Except raceways are not required in accessible indoor ceiling spaces and attics.
  - 2. Except raceways are not required in hollow gypsum board partitions.
  - 3. Conceal raceways and wiring except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. 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.

### 3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install cameras and infrared illuminators level and plumb.
- B. Install cameras with 84-inch-minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.
- C. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.
- D. Install power supplies and other auxiliary components at control stations unless otherwise indicated.
- E. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.
- F. Avoid ground loops by making ground connections only at the control station.
  - 1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.
- G. Identify system components, wiring, cabling, and terminals according to Section 270553 "Identification for Communications Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
  - 1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
  - a. Prepare equipment list described in "Informational Submittals" Article.
  - b. Verify operation of auto-iris lenses.
  - c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
  - d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
  - e. Set and name all preset positions; consult Client Agency's personnel.
  - f. Set sensitivity of motion detection.
  - g. Connect and verify responses to alarms.
  - h. Verify operation of control-station equipment.
3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

- C. Video surveillance system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:
  1. Check cable connections.
  2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
  3. Adjust all preset positions; consult Client Agency's personnel.
  4. Recommend changes to cameras, lenses, and associated equipment to improve Client Agency's use of video surveillance system.
  5. Provide a written report of adjustments and recommendations.

### 3.6 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Client Agency's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

END OF SECTION 282000

## SECTION 282301

### VIDEO SURVEILLANCE HEAD END UPGRADE

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract," "Special Conditions," and "Division 1 - General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

- A. Section includes upgrade to the existing video surveillance system head end and recording equipment.
  - 1. There are no revisions to the CCTV cameras included in the scope of this Section.
  - 2. The work of this Section shall be performed as delegated design.
- B. Related Sections:
  - 1. Section 282000 "Video Surveillance" for new CCTV cameras to be provided at the 4<sup>th</sup> floor.

##### 1.3 DEFINITIONS

- A. FTP: File transfer protocol.
- B. IP: Internet protocol.
- C. LAN: Local area network.
- D. NTSC: National Television System Committee.
- E. PC: Personal computer.
- F. TCP: Transmission control protocol - connects hosts on the Internet.
- G. UPS: Uninterruptible power supply.
- H. WAN: Wide area network.

##### 1.4 SUBMITTALS

- A. Delegated Design Submittal: Provide a complete description of the work required to achieve the specified system requirements, including product data, equipment list, etc. as specified below.

- B. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.
- F. Operation and Maintenance Data: For digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals.
  - 1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

#### 1.5 QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NECA 1.
- C. Comply with NFPA 70.
- D. Delegated Design Entity: Assign delegated design to a firm experienced in the selection, installation and maintenance of the required video surveillance system head end and recording equipment.
  - 1. Installer shall be an authorized installer by the equipment manufacturer.
  - 2. Installer shall have personnel and resources to respond to calls for maintenance and system troubleshooting within 4 hours of placement of a call by the Client Agency.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM REQUIREMENTS

- A. Removal of Existing Equipment: The existing Bosch video management system and recording equipment shall be removed and replaced with upgraded equipment as specified.

- B. Manufacturers: Cognyte (formerly Verint). NO SUBSTITUTIONS.
  - 1. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.7, Substitution of Materials, of the General Conditions to the Construction contract does not apply to the above item.
- C. Upgraded video management and video recording system shall accommodate the existing 48 cameras plus the six (6) cameras being added under this project. Refer to Camera Schedule at the end of this Section.
  - 1. Spare Capacity: In addition to the existing cameras, the system shall accommodate 25 future cameras.
- D. Monitoring: The upgraded system shall accommodate monitoring of the cameras as follows:
  - 1. Command Center G018: Revise the five existing monitors. During the Museum's normal hours of operation, the cameras shall be monitored by PHMC security staff.
  - 2. Capitol Police IMCS: During hours of non-operation at the Museum, cameras shall be monitored by the Capitol Police. The current system does not permit viewing of the Museum cameras at the IMCS.
  - 3. Programmability: The system shall be programmable to revise the hours of monitoring at Command Center G018 or the IMCS.
  - 4. Security Event: During a security event, the system shall permit camera call-up at the IMCS regardless of the time of day.
- E. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.
- F. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.
  - 1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with manufacturer's requirements for surge protection.
  - 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: As recommended by manufacturer for type of line being protected.
- G. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

## 2.2 DIGITAL VIDEO RECORDERS

- A. Manufacturers: Refer to the System Requirements article of this Section for approved proprietary specification.
- B. Storage: Provide for storage of the video for camera quantities identified in Article 2.1.C of this Section for a minimum period of 45 days.

## 2.3 DIGITAL SWITCHERS

- A. Manufacturers: Refer to the System Requirements article of this Section for approved proprietary specification.
- B. Switch: For displaying multiple images on a single monitor. Provide color switcher.
  - 1. Match the existing camera display per monitor quantities.
  - 2. Controls: Unit-mounted front panel.
  - 3. Resolution: 720 by 480 lines.
  - 4. Modes: Auto, manual, and alarm. In manual mode, each channel can also be viewed in single display mode. In the event of an alarm, alarming channel shall automatically switch to full screen. If several alarms are activated, channels in alarm shall be in auto-switching mode.
  - 5. Channel Loss Alarm: Audible buzzer; occurrence details shall be recorded.
  - 6. Time: Indicate date and time.
  - 7. Timing of Auto-Switcher: 1 to 30 seconds, selectable.
  - 8. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E, or freestanding desktop.
- C. Manual Switch Bank: Low-loss, high-isolation, multiple-video switch to allow manual switching of multiple quad switches and cameras to a single output. Switches shall be illuminated.
- D. Sequential Switchers: Automatically sequence outputs of multiple cameras to single monitor and videotape recorder.
  - 1. Switching Time Interval: Continuously adjustable, 5 to 20 seconds minimum, with manual override.
  - 2. Skip-Sequential-Hold Switch: One for each camera, with LED to indicate active camera.
  - 3. Camera Identification Legend: Either on-screen message or label at skip-sequential switch.
  - 4. Alarm Switching: In the event of an alarm, alarming channel shall automatically switch the monitor to full screen.
  - 5. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.

## 2.4 CONTROL STATIONS

- A. Manufacturers: Refer to the System Requirements article of this Section for approved proprietary specification.
- B. Description: Heavy-duty, freestanding, modular, metal furniture units arranged to house electronic equipment. Coordinate component arrangement and wiring with components and wiring of other systems.
- C. Equipment Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.
- D. Normal System Power Supply: 120 V, 60 Hz, through a locked disconnect device and an isolation transformer in central-station control unit. Central-station control unit shall supply power to all components connected to it unless otherwise indicated.
- E. Power Continuity for Control Station: Batteries in power supplies of central-station control units and individual system components shall maintain continuous system operation during outages of both normal and backup ac system supply.



1. Batteries: Rechargeable, valve-regulated, recombinant, sealed, lead-acid type with nominal 10-year life expectancy. Capacity adequate to operate portions of system served including audible trouble signal devices for up to four hours and audible and visual alarm devices under alarm conditions for an additional 10 minutes.
  2. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Charger shall recharge fully discharged battery within 24 hours.
- F. Annunciation: Indicate change in system condition and switching of system or component to backup power.

## PART 3 - EXECUTION

### 3.1 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install equipment in accordance with manufacturer's written instructions.
- B. Install power supplies and other auxiliary components at control stations unless otherwise indicated.

### 3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
  2. Pretesting: Adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
    - a. Prepare equipment list described in "Informational Submittals" Article.
    - b. Verify operation of control-station equipment.
  3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
  4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
- D. Video surveillance system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.3 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.4 DEMONSTRATION

- A. Client Agency's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

END OF SECTION 282301

## EXISTING CCTV CAMERA SCHEDULE

**CCTV:** Four monitors in the command center

### DVR Bosch 700 DHR75316A 2TB

DIVAR 1 INPUT 1 MUSEUM 1ST FLOOR PLAZA EXIT  
DIVAR 1 INPUT 2 2ND SOUTH SECTION SLEIGH  
DIVAR 1 INPUT 5 GROUND ARCHIVE DOCK CAMERA INTERIOR  
DIVAR 1 INPUT 7 GND FLR MUSEUM FREIGHT HALL TOWARDS DOCK OVER  
DIVAR 1 INPUT 8 MUSEM GROUND FLOOR HALLWAY BY NORTH STREET EN  
DIVAR 1 INPUT 9 A1 BREAKROOM EXIT  
DIVAR 1 INPUT 10 MUS/ARCH HALLWAY KEYSTONE END  
DIVAR 1 INPUT 11MUS/ARCH HALLWAY 3RD STREET EXIT  
DIVAR 1 INPUT 12ARCHIVE N HALLWAY LOOKING TOWARD 3RD STREET  
DIVAR 1 INPUT 16 5TH FLOOR FREIGHT

### DVR Bosch DVR-670-16A00

DIVAR 2 INPUT 1 GND DOUBLE DOORS BY FREIGHT HALLWAY SIDE  
DIVAR 2 INPUT 2 2ND NE CIVIL WAR  
DIVAR 2 INPUT 3 4TH FLOOR PASSENGER ELEV AND HALL  
DIVAR 2 INPUT 4 5TH FLOOR RECEPTION  
DIVAR 2 INPUT 5 VENDING MACHINE CAMERA GND  
DIVAR 2 INPUT 7 GND MAIN ENTRANCE NW BOAT  
DIVAR 2 INPUT 9 1ST N SECTION  
DIVAR 2 INPUT 10 1ST NW SECTION VIEW A  
DIVAR 2 INPUT 11GND HALLWAY NEXT TO AUDITORIUM  
DIVAR 2 INPUT 14 MUSEUM GND FLOOR CURIOSITY CORNER  
DIVAR 2 INPUT 15 GND MAIN ENTRANCE SW BOAT

### DVR BOSCH ND-6650A

DIVAR 3 INPUT 1 (33) 4TH FLOOR PASSENGER ELEV AND HALL  
DIVAR 3 INPUT 2 (34) PARKING GARAGE SE  
DIVAR 3 INPUT 3 (35) ARCHIVES SW HALL  
DIVAR 3 INPUT 4 (36) 3RD SW SECTION MAMMEL HALL  
DIVAR 3 INPUT 5 (37) PARKING GARAGE PTZ 37 WEST WALL  
DIVAR 3 INPUT 6 (38) 4TH FLOOR FREIGHT ELEVATOR  
DIVAR 3 INPUT 7 (39) GND GIFT SHOP NE CORNER  
DIVAR 3 INPUT 8 (40) DOCK EAST WALL PTZ 40  
DIVAR 3 INPUT 9 (41) 1ST FLOOR VILLAGE HADWARE STORE IP 192.168.10.49  
DIVAR 3 INPUT (42) 10 KIDS DISPLAY GND SW  
DIVAR 3 INPUT 11 (43) 3RD N SECTION FREIGHT VIEW  
DIVAR 3 INPUT 12 (44) CONNECTING HALLWAY BETWEEN MUSEUM AND ARCHI  
DIVAR 3 INPUT 13 (45) GND ARCHIVES ENTRANCE TO KEYSTONE  
DIVAR 3 INPUT 14 (46) 1ST SOUTH SECTION  
DIVAR 3 INPUT 15 (47) 2ND NORTH SECTION DIG VIEW A  
DIVAR 3 INPUT 16 (48) GND DOUBLE DOORS BY FREIGHT HALLWAY SIDE

NVR BOSCH - DIVAR IP 2000 2X2TB

1FL CHARTER IP CAMERA 192.168.17.85  
1ST FLOOR VIEW Gallery A IP CAMERA 192.168.10.43  
1ST FLOOR VIEW B IP CAMERA 192.168.10.41  
1ST FLOOR VIEW C IP CAMERA 192.168.10.45  
1ST FLOOR VIEW D IP CAMERA 192  
1ST FLOOR VIEW D IP CAMERA 192.168.10.42  
1ST FLOOR VIEW E IP CAMERA 192.168.10.44  
RAIN FOREST IP CAMERA  
MONEY COUNTING IP CAMERA 192.168.10.24  
GIFT SHOP IP CAMERA 192.168.10.25  
MOON ROCK IP CAMERA

NEW CCTV CAMERA SCHEDULE

The following cameras are being added under Project C-0946-0012 Phase 4 and shall be accommodated in the CCTV camera head-end equipment upgrade along with the existing cameras.

NORTH CORRIDOR 435  
CENTRAL CORRIDOR NORTH 433  
CENTRAL CORRIDOR SOUTH 433  
NORTHWEST CORRIDOR 436  
SOUTHWEST CORRIDOR 442  
SOUTH CORRIDOR 451

## SECTION 283111

### DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

#### PART 1 - GENERAL

##### 1.1 STIPULATIONS

- A. The specification sections "General Conditions of the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 SUMMARY

###### A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Air-sampling smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Device guards.
8. Firefighters' smoke-control station. (integrated with FACP).
9. Magnetic door holders.
10. Addressable interface device.
11. Digital alarm communicator transmitter.
12. Network communications.
13. System printer.
14. Emergency responder radio coverage.

###### B. Related Requirements:

1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for cables and conductors for fire-alarm systems.
2. Section 284700 "Mass Notification" for mass notification features that are required in addition to fire-alarm system and equipment requirements specified in this Section.

##### 1.3 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. HLI: High Level Interface.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. PC: Personal computer.

- F. VESDA: Very Early Smoke-Detection Apparatus.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

- B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
  - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
  - b. Show field wiring required for HVAC unit shutdown on alarm.
  - c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
  - d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
  - e. Locate detectors according to manufacturer's written recommendations.
  - f. Show air-sampling detector pipe routing.
13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

- C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Professional.
2. Shop Drawings shall be prepared by persons with the following qualifications:
  - a. Trained and certified by manufacturer in fire-alarm system design.

- b. NICET-certified, fire-alarm technician; Level III minimum.
  - c. Licensed or certified by authorities having jurisdiction.
- D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional responsible for their preparation.
- 1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
  - 2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
  - 3. Indicate audible appliances required to produce square wave signal per NFPA 72.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
    - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
    - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
    - d. Riser diagram.
    - e. Device addresses.
    - f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
    - g. Record copy of site-specific software.
    - h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
      - 1) Equipment tested.
      - 2) Frequency of testing of installed components.
      - 3) Frequency of inspection of installed components.
      - 4) Requirements and recommendations related to results of maintenance.
      - 5) Manufacturer's user training manuals.

- i. Manufacturer's required maintenance related to system warranty requirements.
- j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.
8. Filters for Air-Sampling Detectors: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
9. Air-Sampling Fan: Quantity equal to one for every five detectors, but no fewer than one unit of each type.

## 1.8 QUALITY CONTROL

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
- C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).
- D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.
- E. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.
- F. NFPA Certification: Obtain certification according to NFPA 72.



## 1.9 PROJECT CONDITIONS

- A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Using Agency or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
  - 1. Notify Professional no fewer than seven days in advance of proposed interruption of fire-alarm service.
  - 2. Do not proceed with interruption of fire-alarm service without Professional's written permission.
- C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

## 1.10 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

## 1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## 1.12 PRE-INSTALLATION MEETING

- A. The .4 Contractor shall participate in the stair pressurization pre-installation meeting. The pre-installation meeting shall be scheduled for the same day as a regular, weekly construction meeting. The pre-installation meeting shall be scheduled immediately before or after the regular construction meeting whenever possible.
  - 1. The meeting shall be attended by the manufacturer's representative and all the .4 Contractor's tradespersons and their sub-contractors having installation, start-up, or commissioning duties related to the system and equipment. The meeting agenda shall be prepared by the .2 Contractor shall be distributed to all concerned parties no less than 2 days prior to the meeting, along with a copy of the manufacturer's installation instructions. Documents shall be uploaded to e-Builder.
  - 2. The manufacturer's representative shall review the final equipment and material submittals and all of the manufacturer's requirements of the installation, including mounting, wiring connections, and startup / commissioning requirements. The

- representative shall also review all work required to be completed prior to start-up of the equipment, including the provisions of this Section.
3. The .2 Contractor shall provide a written record of the meeting including date and a list of attendees, and shall upload this report to e-Builder.
    - a. The .4 Contractor will utilize the Pre-Installation Meeting Agenda and Pre-Installation Meeting Checklist documents in the Z Standard Training & Documentation: Documents \ 03 - Construction - Training and Guidance Documents \ 03 - Role Based Training and Guidance Documents \ Contractors.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing Siemen's MVL system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
  1. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.
- B. Noncoded, addressable system, with multiplexed signal transmission and voice/strobe evacuation.
- C. Automatic sensitivity control of certain smoke detectors.
- D. All components provided shall be listed for use with the selected system.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
  1. Manual stations.
  2. Heat detectors.
  3. Flame detectors.
  4. Smoke detectors.
  5. Duct smoke detectors.
  6. Air-sampling smoke-detection system (VESDA).
  7. Automatic sprinkler system water flow.
  8. Preaction system.
  9. Fire-extinguishing system operation.
  10. Fire standpipe system.
  11. Dry system pressure flow switch.
  12. Fire pump running.

- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances, including voice evacuation notices.
  2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
  3. Transmit an alarm signal to the remote alarm receiving station.
  4. Unlock electric door locks in designated egress paths.
  5. Release fire and smoke doors held open by magnetic door holders.
  6. Activate voice/alarm communication system.
  7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
  8. Activate stair pressurization at the FACP.
  9. Activate stairwell and elevator-shaft pressurization systems.
  10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
  11. Activate preaction system.
  12. Recall elevators to primary or alternate recall floors.
  13. Record events in the system memory.
  14. Record events by the system printer.
  15. Indicate device in alarm on the graphic annunciator.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
  2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
  3. Alert and Action signals of air-sampling detector system.
  4. Elevator shunt-trip supervision.
  5. Fire pump running.
  6. Fire-pump loss of power.
  7. Fire-pump power phase reversal.
  8. Independent fire-detection and -suppression systems.
  9. User disabling of zones or individual devices.
  10. Loss of communication with any panel on the network.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
  2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
  4. Loss of primary power at fire-alarm control unit.
  5. Ground or a single break in internal circuits of fire-alarm control unit.
  6. Abnormal ac voltage at fire-alarm control unit.
  7. Break in standby battery circuitry.
  8. Failure of battery charging.
  9. Abnormal position of any switch at fire-alarm control unit or annunciator.
  10. Voice signal amplifier failure.
- E. System Supervisory Signal Actions:
1. Initiate notification appliances.
  2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
  3. Record the event on system printer.
  4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

5. Transmit system status to building management system.
6. Display system status on graphic annunciator.

## 2.3 FIRE-ALARM CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Siemens Industry, Inc.; Fire Safety Division.
2. Or equal as approved by Design Professional.

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
  - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
  - b. Include a real-time clock for time annotation of events on the event recorder and printer.
  - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
  - d. The FACP shall be listed for connection to a central-station signaling system service.
  - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, three line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 1.
3. Install no more than 100 addressable devices on each signaling-line circuit.
4. Serial Interfaces:
  - a. One dedicated RS 485 port for [central-station] [remote station] operation using point ID DACT.

- b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
  - c. One [USB] [RS 232] port for PC configuration.
  - d. One RS 232 port for voice evacuation interface.
- E. Stairwell Pressurization: Provide an output signal using an addressable relay to start the stairwell pressurization system. Signal shall remain on until alarm conditions are cleared and fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.
  - 1. Pressurization starts when any alarm is received at fire-alarm control unit.
  - 2. Alarm signals from smoke detectors at pressurization air supplies have a higher priority than other alarm signals that start the system.
  - 3. Provide HOA switch at FACP for control of stair pressurization system per stair tower.
  - 4. Provide monitoring and visual indication of fan status, system in manual, trouble and supervisory conditions.
- F. Smoke-Alarm Verification:
  - 1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
  - 2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
  - 3. Record events by the system printer.
  - 4. Sound general alarm if the alarm is verified.
  - 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- G. Notification-Appliance Circuit:
  - 1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
  - 2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- H. Elevator Recall:
  - 1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
    - a. Elevator lobby detectors except the lobby detector on the designated floor.
    - b. Smoke detector in elevator machine room.
    - c. Smoke detectors in elevator hoistway.
  - 2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
  - 3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
    - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- I. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall not be connected to fire-alarm system.
- J. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-

adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

- K. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station at the Capitol Police.
- L. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet located in the fire command center.
  - 1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
    - a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
    - b. Programmable tone and message sequence selection.
    - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.
  - 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
  - 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- M. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- N. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals shall be powered by 24-V dc source.
  - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- O. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
  - 1. Batteries: Sealed lead calcium.
- P. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

## 2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with attached addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
  2. Station Reset: Key- or wrench-operated switch.
  3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
  4. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

## 2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
  3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
  6. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    - a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    - b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    - c. Multiple levels of detection sensitivity for each sensor.
    - d. Sensitivity levels based on time of day.
- B. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.

- e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

## 2.6 MULTICRITERIA DETECTORS

- A. Mounting: Twist-lock base interchangeable with smoke-detector bases.
- B. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.
- D. Test button tests all sensors in the detector.
- E. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  1. Primary status.
  2. Device type.
  3. Present sensitivity selected.



4. Sensor range (normal, dirty, etc.).
- F. Sensors: The detector shall be comprised of four sensing elements including a smoke sensor, a carbon monoxide sensor, an infrared sensor, and a heat sensor.
1. Smoke sensor shall be photoelectric type as described in "System Smoke Detectors" Article.
  2. Heat sensor shall be as described in "Heat Detectors" Article.
  3. Each sensor shall be separately listed according to requirements for its detector type.

## 2.7 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- D. Continuous Linear Heat-Detector System:
1. Detector Cable: Rated detection temperature 155 deg F. Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.
  2. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
  3. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
  4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

## 2.8 NOTIFICATION APPLIANCES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Siemens Industry, Inc.; Fire Safety Division.
  2. Or equal as approved by Design Professional.

- B. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
- C. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
  - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- D. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
  - 1. Rated Light Output:
    - a. 15/30/75/110 cd, selectable in the field as indicated on the drawings.
  - 2. Mounting: Wall mounted unless otherwise indicated.
  - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
  - 4. Flashing shall be in a temporal pattern, synchronized with other units.
  - 5. Strobe Leads: Factory connected to screw terminals.
  - 6. Mounting Faceplate: Factory finished, white.
- E. Voice/Tone Notification Appliances:
  - 1. Comply with UL 1480.
  - 2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
  - 3. High-Range Units: Rated 2 to 15 W.
  - 4. Low-Range Units: Rated 1 to 2 W.
  - 5. Mounting: Flush, semirecessed or surface mounted and bidirectional.
  - 6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

## 2.9 FIREFIGHTERS' SMOKE-CONTROL SYSTEM

- A. Initiate Smoke-Management Sequence of Operation:
  - 1. Comply with sequence of operation as described in Section 230993.11 "Sequence of Operations for HVAC DDC."
  - 2. Fire-alarm system shall provide all interfaces and control points required to properly activate smoke-management systems.
  - 3. First fire-alarm system initiating device to go into alarm condition shall activate the smoke-control functions.
  - 4. Subsequent devices going into alarm condition shall have no effect on the smoke-control mode.

- B. Addressable Relay Modules:
  - 1. Provide address-setting means on the module. Store an internal identifying code for control panel use to identify the module type.
  - 2. Allow the control panel to switch the relay contacts on command.
  - 3. Have a minimum of two normally open and two normally closed contacts available for field wiring.
  - 4. Listed for controlling HVAC fan motor controllers.

## 2.10 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
  - 1. Electromagnets: Require no more than 3 W to develop 25-lbf holding force.
  - 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
  - 3. Rating: 24-V ac or dc.
  - 4. Rating: 120-V ac.
- B. Material and Finish: Match door hardware.

## 2.11 ADDRESSABLE INTERFACE DEVICE

- A. General:
  - 1. Include address-setting means on the module.
  - 2. Store an internal identifying code for control panel use to identify the module type.
  - 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall, to circuit-breaker shunt trip for power shutdown.
  - 1. Allow the control panel to switch the relay contacts on command.
  - 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
  - 1. Operate notification devices.
  - 2. Operate solenoids for use in sprinkler service.

## 2.12 NETWORK COMMUNICATIONS

- A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.
- B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

- C. Provide integration gateway using BACnet or Modbus for connection to the existing Capitol Campus fire alarm system.

#### 2.13 SYSTEM PRINTER

- A. Printer shall be listed and labeled as an integral part of fire-alarm system.

#### 2.14 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
  - 1. Factory fabricated and furnished by device manufacturer.
  - 2. Finish: Paint of color to match the protected device.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
  - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
  - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
  - 1. Connect new equipment to existing control panel in existing part of the building.
  - 2. Connect new equipment to existing monitoring equipment at the supervising station.

3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- C. Manual Fire-Alarm Boxes:
1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
  2. Mount manual fire-alarm box on a background of a contrasting color.
  3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Smoke- or Heat-Detector Spacing:
1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
  2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
  3. Smooth ceiling spacing shall not exceed 30 feet.
  4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
  5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
  6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
- E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- I. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
- K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

### 3.3 PATHWAYS

- A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.
  - 1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.
- B. Pathways shall be installed in EMT.
- C. Exposed EMT shall be painted red enamel.

### 3.4 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
  - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
  - 3. Smoke dampers in air ducts of designated HVAC duct systems.
  - 4. Magnetically held-open doors.
  - 5. Electronically locked doors and access gates.
  - 6. Alarm-initiating connection to elevator recall system and components.
  - 7. Alarm-initiating connection to activate emergency lighting control.
  - 8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
  - 9. Supervisory connections at valve supervisory switches.
  - 10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
  - 11. Supervisory connections at elevator shunt-trip breaker.
  - 12. Data communication circuits for connection to building management system.
  - 13. Data communication circuits for connection to mass notification system.
  - 14. Supervisory connections at fire-extinguisher locations.
  - 15. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
  - 16. Supervisory connections at fire-pump engine control panel.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.6 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

### 3.7 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by Professional.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Perform the following tests and inspections with the assistance of a factory-authorized service representative]:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
  - 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
  - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
  - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

### 3.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

### 3.9 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Using Agency to schedule access to system and to upgrade computer equipment if necessary.

### 3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Using Agency's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111