

**PROJECT MANUAL**

**DMVA PROJECT NO. 42190067**

**For**

**RENOVATIONS TO  
FORT MIFFLIN BUILDING #57  
PHILADELPHIA – PHILADELPHIA COUNTY – PENNSYLVANIA**

**COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF MILITARY AND VETERANS' AFFAIRS  
HARRISBURG, PENNSYLVANIA**

**JOSH SHAPIRO, GOVERNOR  
Major General MARK J. SHINDLER, THE ADJUTANT GENERAL**

**Date: 31 March 2023**

**DEPARTMENT OF MILITARY AND VETERANS' AFFAIRS  
Office of Facilities and Engineering  
Bureau of Design and Project Management  
Bldg. 0-10, Ft. Indiantown Gap  
Annville, Lebanon County, Pa. 17003  
Phone: (717) 861-9748 Fax: (717) 861-8583**

## DRAWINGS

### NUMBER AND TITLE OF DRAWINGS

The drawings which form a part of this project are indicated in the following list.

G.1.0	COVER SHEET
A.1.1	FLOOR PLAN
A.2.1	ENLARGED FLOOR PLANS
A.2.2	CEILING JOIST LAYOUT
A.3.1	SCHEDULES AND DETAILS
H.1.1	HVAC PLANS
H.2.1	HVAC DETAILS
P.1.1	PLUMBING PLAN & DETAILS
P.2.1	PLUMBING SITE PLAN
E.1.1	DEMO AND LIGHTING PLAN
E.2.1	POWER PLANS
E.3.1	TECH PLAN, NOTES AND SYMBOLS

The above is an exact list of the drawings included under **DMVA Project No. 42190067** and shall be considered a part thereof.

The Bureau of Design and Project Management will furnish from time to time as the work progresses, such supplemental drawings as may be required for further illustrating the details of the work, but these supplemental drawings will not include the shop drawings, all of which are to be prepared by the Contractor and submitted as hereinafter specified for approval before the work is started.

## TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE NO.</u>	
<b><u>DIVISION 01</u></b>			
<b><u>GENERAL REQUIREMENTS</u></b>			
Section 010100	Summary of Work	010100-1	010100-4
Section 010400	Coordination and Control	010400-1	010400-4
Section 013100	Sequence of Construction & Milestones	013100-1	013100-2
Section 013300	Submittals	013300-1	013300-2
Section 014000	Quality Control/Inspection Procedures	014000-1	041000-7
Section 017700	Closeout Procedures	017700-1	017700-4
Section 017823	Operation and Maintenance Data	017823-1	017823-7
Section 017839	Project Record Documents	017839-1	017839-3
<b>GENERAL CONSTRUCTION</b>			
<b><u>DIVISION 02</u></b>			
<b><u>MASONRY</u></b>			
Section 024119	Selective Demolition	024119-1	024119-5
Section 024120	Cutting and Patching	024120-1	024120-3
<b><u>DIVISION 04</u></b>			
<b><u>MASONRY</u></b>			
Section 040120	Masonry Repair	040120-1	040120-9
<b><u>DIVISION 05</u></b>			
<b><u>METALS</u></b>			
Section 054000	Load Bearing Metal Framing	054000-1	054000-8
Section 055213	Pipe and Tube Railings	055213-1	055213-10
<b><u>DIVISION 06</u></b>			
<b><u>WOOD, PLASTICS, AND COMPOSITES</u></b>			
Section 061053	Miscellaneous Rough Carpentry	061053-1	061053-4
<b><u>DIVISION 07</u></b>			
<b><u>THERMAL AND MOISTURE PROTECTION</u></b>			
Section 079200	Joint Sealants	079200-1	079200-7
<b><u>DIVISION 08</u></b>			
<b><u>OPENINGS</u></b>			
Section 081113	HM Doors and Frames	081113-1	081113-4
Section 083323	Overhead Coiling Doors	083323-1	083323-6
Section 087111	Door Hardware	087111-1	087111-16
<b><u>DIVISION 09</u></b>			
<b><u>FINISHES</u></b>			
Section 092900	Gypsum Board	092900-1	092900-5
Section 095123	Acoustical Tile Ceilings	095123-1	095123-7
Section 096513	Vinyl Wall Base	096513-1	096513-5
Section 097200	Wall Covering	097200-1	097200-3
Section 099123	Interior Painting	099123-1	099123-6

Section 099600	Epoxy Floor Coatings	099600-1	099600-5
Section 099726	Cementitious Coatings	099726-1	099726-4

**DIVISION 10**

**SPECIALTIES**

Section 101400	Signage	101400-1	101400-3
Section 102113	Toilet Compartments	102113-1	102113-5
Section 102800	Toilet Room Accessories	102800-1	102800-4

**DIVISION 12**

**FURNISHINGS**

Section 123623.13	Laminate Countertops	12623.13-1	12623.13-5
-------------------	----------------------	------------	------------

**HVAC CONSTRUCTION**

**DIVISION 23**

**HEATING VENTILATION AND AIR CONDITIONING**

Section 230510	HVAC Electrical Equipment and Wiring Requirments	230510-1	230510-3
Section 230515	HVAC Piping, Materials, Equipment & Methods	230515-1	230515-8
Section 230520	HVAC Specialties	230520-1	230520-5
Section 230553	Mechanical Identification	230553-1	230553-4
Section 230590	HVAC Testing, Adjusting & Balancing	230590-1	230593-4
Section 230713	HVAC Duct Insulation	230713-1	230713-18
Section 230900	HVAC Instrumentation And Controls	230900-1	230900-34
Section 233110	Ductwork, Accessories & Sheetmetal Specialties	233110-1	233113-7
Section 233400	Overhead Fans	233400-1	233400-7
Section 233423	HVAC Power Ventilators	233423-1	233423-4
Section 233710	Air Inlets and Outlets	233710-1	233713-2
Section 235400	Furnaces	235400-1	235400-9
Section 238126	Split-System Air-Conditioners	238126-1	238126-7

**PLUMBING CONSTRUCTION**

**DIVISION 22**

**PLUMBING**

Section 221110	Plumbing Piping	221110-1	221110-5
Section 221310	Plumbing Specialties	221310-1	221310-3
Section 223300	Electric, Domestic-Water Heaters	223300-1	223300-4
Section 224000	Plumbing Fixtures	224000-1	224000-8

**ELECTRICAL CONSTRUCTION**

**DIVISION 26**

**ELECTRICAL**

Section 260500	Common Work Results for Electrical	260500-1	260500-3
Section 260510	Electrical Equipment Wiring	260510-1	260510-4
Section 260519	Low-Voltage Electrical Power Conductors & Cables	260519-1	260519-4
Section 260526	Grounding and Bonding	260526-1	260526-5

Section 260529	Hangers & Supports for Electrical Systems	260529-1	260529-4
Section 260533	Raceway & Boxes for Electrical Systems	260533-1	260533-5
Section 260553	Identification for Electrical Systems	260553-1	260553-5
Section 260923	Lighting Control Devices	260923-1	260923-3
Section 262416	Panelboards	262416-1	262416-5
Section 262713	Electricity Metering	262713-1	262713-4
Section 262726	Wiring Devices	262726-1	262726-5
Section 262813	Fuses	262813-1	262813-3
Section 262816	Enclosed Switches and Circuit Breakers	262816-1	262816-3
Section 265100	Interior Lighting	265100-1	265100-5
<b><u>DIVISION 27</u></b>			
	<b><u>COMMUNICATIONS</u></b>		
Section 270500	Common Work for Communications	270500-1	270500-4
Section 271300	Communications Backbone Cabling	271300-1	271300-10
Section 271500	Communications Horizontal Cabling	271500-1	271500-13

SECTION 010100  
SUMMARY OF WORK

PART 1 – GENERAL

1.1 STIPULATIONS

- a. The General Conditions, drawings and all other attached documents form a part of this Section and all other Sections by reference thereto and have the same force and effect as if printed herewith in full. The Contractor shall be strictly accountable for the cognizance of carrying out the provisions thereof. Contractor shall note that reference to “Project Design Documents” refers to all documentation included within the Project Bid and/or Award Package. This includes, but is not limited to drawings, specifications, Government forms, contractual literature, etc.

1.2 SCOPE OF WORK, GENERAL

- a. The work under this Contract shall generally consist of, but not necessarily be limited to, providing all labor, material, devices, tools and equipment required for the renovations to Building #57, located at Fort Mifflin, PA National Guard Readiness Center, Philadelphia County, PA and shall be in total accordance with the specifications and drawings and subject to the terms and conditions of all other Contract Documents.

1.3 PERFORMANCE PERIOD

- a. ***Three Hundred (300)*** calendar days from Government granted Notice to Proceed.

1.4 WAGE SCALES

- a. Wage Scales ARE REQUIRED to be paid on this Project.

1.5 QUESTIONS DURING BID PROCESS

- a. Direct all questions pertaining to the project as shown and described in the contract documents to both persons listed below.

Mr. Raymond Fishburn, Architectural Supervisor  
DMVA, Bureau of Design and Project Management  
Bldg. 0-10, Fort Indiantown Gap  
Annville, PA 17003  
Email: rafishburn@state.pa.us  
Ph.: 717.861.8221                      Fax: 717.861.8683

Ms. Tina L. Rebeck, Procurement Specialist  
Department of Military and Veterans Affairs State Contracting Office  
Building 0-47, Fort Indiantown Gap  
Annville, PA 17003

- b. Should the contractor submit an RFI via email, the subject line shall appear as follows:
  - 1. **DMVA Project#: 42190067 Renovations to Fort Mifflin Building #57**
  - 2. Additional information can be included thereafter.

## 1.6 SUBMITTALS

- a. See individual Sections and “SCHEDULE OF MATERIAL SUBMITTALS (AF FORM 66)” included within the project Design Documents
- b. Submittals shall be forwarded to Department of Military & Veteran’s Affairs; Bureau of Design and Project Management, Building 0-10, Fort Indiantown Gap, Annville, Pa 17003
- c. Each submittal shall include the following:
  - 1. Project number
  - 2. Contract number
  - 3. Related specification section
  - 4. Contractor’s approval stamp
  - 5. Contractors initials and date
  - 6. Area for DMVA-BMCE review stamp
- d. All submittals must be approved by the discipline responsible, DMVA-BDPM **Design Professional** prior to incorporation into the project.

## 1.7 REQUIRED WARRANTIES

- a. Contractor shall provide all required warranties as outlined within the Project Design Specifications and on all included Government AF Form 66’s.

## PART 2 – OUTLINE OF REQUIRED WORK

- 2.1 The work of this project consists of but is not necessarily limited to the following. Detailed requirements of the work are described on the pertinent specification sections and/or shown on the drawings.
  - a. (GENERAL – POINT 1)
    - 1. Prepare and submit all necessary pre-construction documentation as outlined within the project Design Documents.
    - 2. Perform demolition, repair and initial clean-up services.
    - 3. Install new frames, doors and associated hardware.
    - 4. Construct new stud walls and ceiling joists.
    - 5. Install new room finishes to include; wall, ceiling and floor finishes.

6. Install new countertops, toilet partitions, urinal partitions and all other toilet room accessories as outlined with the project design documents.
  7. Complete Punch Lists and Final Cleaning.
  8. Provide all required closeout documentation and training per the Project Design Documents prior to deeming/granting the project complete.
- b. (HVAC – POINT 2)
1. Prepare and submit all necessary pre-construction documentation as outlined within the project Design Documents.
  2. Construct/Install all HVAC ductwork, duct accessories & Insulation per Project Design Documents.
  3. Install new ducted split system with propane gas furnace for new offices and conference room.
  4. Install new ductless split for IT closet.
  5. Install three new overhead “Big Ass Fans” in assembly area.
  6. Install Duct Accessories, Diffusers and Registers as per Project Design Documents.
  7. Install all toilet room Exhaust fans related ductwork per the Project Design Documents.
  8. Provide certified Testing, balancing and Adjustment to HVAC System and Reports.
  9. Provide all required closeout documentation and training per the Project Design Documents prior to deeming/granting the project complete.
- c. (PLUMBING – POINT 3)
1. Excavations & Installation of Sanitary Waste.
  2. Install new sewage lift station and extend forced main as per Project Design Documents.
  3. Indoor Sanitary Waste and Vent Line Installation.
  4. Plumbing Fixtures Installation and Rough-Ins.
  5. Indoor Domestic Water Line installation and related Insulation, including hot and cold-water piping to fixtures as indicated on the plumbing drawings.
  6. Extend existing water main from Building #56 to Building #57 as indicated on the plumbing drawings.
  7. Installation of Tankless type water heater.
  8. Final Cleaning, Punch List Items, Close-Out Documents.
- d. (ELECTRICAL – POINT 4)
1. Prepare and submit all necessary pre-construction documentation as outlined within the Project Design Documents.
  2. Provide all electrical service equipment per Project Design Documents.
  3. Provide all trenching, conduits, foundations, and equipment as per Project Design Documents.
  4. Provide all electrical distribution panels and equipment as per the Project Design Documents.



5. Provide all lighting, controls, sensors, and devices as per the Project Design Documents.
6. Install all branch circuits, outlets, devices, fixtures, and sensors as per Project Design Documents.
7. Provide all communications equipment, cable, splices, terminations, testing, conduit, and the like as per Project Design Documents.
8. Complete Punch Lists and Final Cleaning.
9. Provide all required closeout documentation and training per the Project Design Documents prior to deeming/granting the project complete.

END OF SECTION 010100

SECTION 011200  
COORDINATION AND CONTROL

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The General Conditions, drawings and all other attached documents form a part of this Section and all other Sections by reference thereto and have the same force and effect as if printed herewith in full. The Contractor shall be strictly accountable for the cognizance of carrying out the provisions thereof.

1.2 SUMMARY

- A. Section includes a summary of each contract, including responsibilities for coordination and temporary facilities and controls that govern the performance of the work to complete this project.
- B. Specific requirements for work of each contract are also indicated in individual Specification Sections and on Drawings.

1.3 PRIME CONTRACTS FOR CONSTRUCTION

- A. Point 1 – General (Lead)
- B. Point 2 – HVAC
- C. Point 3 – Plumbing
- D. Point 4 – Electrical

1.4 WORK HOURS

- A. Regular work hours will be Monday through Friday, 7:00 am to 4:30 pm.
- B. Holidays: No work will be allowed on holidays observed by the State and Federal Government.
- C. Weekends: No work will be allowed on weekends.
- D. Exceptions: If deemed necessary, exceptions to the above can be made. Prime Contractors must submit, in writing, justification for such an exception and approval from the Department must be obtained prior to commencement of any work.

1.5 COORDINATION

- A. The General Contractor shall be responsible for coordination between all contracts.

1. Construction operations shall be coordinated to ensure efficient and orderly installation of each part of the work.
2. Coordinate installation of different components with other Contractors to ensure accessibility for required construction operations.
3. Make necessary provisions to accommodate items scheduled for later installation.

## PART 2 - TEMPORARY FACILITIES AND EQUIPMENT

### 2.1 GENERAL

- A. It shall be the responsibility of each Contractor to provide, maintain, and remove all facilities and equipment necessary for construction operations for individual Contracts. All restoration required due to contract operations, shall be the responsibility of each individual Contractor for his location/area of operation, at no expense to the Department. Where there is conflict with responsibility, the General Contractor shall be responsible for restoration, at no cost to the Department.
  1. These items include, but are not limited to:
    - a. Costs and use charges associated with the facility.
    - b. Plug-in cords, power cords, and extension cords, power tools.
    - c. Task lighting and special lighting necessary for construction operations.
    - d. Storage and fabrication structures/areas.
    - e. Temporary enclosures for construction activities.
    - f. Hoisting equipment for construction activities.
    - g. Waste disposal facilities, including collection and legal disposal of its own waste materials.
    - h. Daily cleaning of work area.
    - i. Secure lockup of tools, materials, and equipment.
    - j. Construction aids, services, and facilities necessary for individual construction activities.

### 2.2 FIELD OFFICES

#### A. CONTRACTOR TRAILERS/OFFICES

1. The Prime Contractor(s) shall provide and maintain, at their cost, a suitable office on the premises. Trailer/offices shall be located based on the staging area depicted on the Project Design Documents and/or the location determined during the Pre-Construction Coordination Meeting. The Contractor shall provide and maintain all necessary services and utilities for their respective offices and/or trailers, to include, but not limited to; electrical services, sanitary and water services, heating and cooling, telephone/fax and internet services.

#### B. SANITARY FACILITIES

1. Portable Toilets (Porta Johns) – Point 1 General Contractor (Lead), at their costs, shall be responsible for providing and maintaining any and all temporary toilet facilities. Toilets are to be utilized by all persons (Contractors, Sub-Contractors, DMVA Personnel, etc.) associated with the project.
  - a. Cleaning, Pumping and Maintenance of the portable toilets shall be the responsibility of the Point 1 General Contractor.

### PART 3 - TEMPORARY SERVICES/UTILITIES DURING CONSTRUCTION

#### 3.1 CONTRACTOR RESPONSIBILITIES

- A. The General Contractor shall be responsible for all temporary heating, cooling, ventilation, power, lighting and water/sewer. This shall include, unless otherwise indicated, utility-use charges, temporary meters, and temporary connections, necessary during construction operations.
- B. The designated Contractor shall install, operate, protect, and maintain the respective temporary services as specified herein during the duration of the entire project.
- C. Temporary connections to new and/or existing permanent service lines shall be made at locations as directed by the Department, 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.
- D. 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).

#### 3.2 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 1.4 on 'Working Hours'.

#### 3.3 WELDING

- A. Any Contractor using electrical power for welding on the site shall use self-contained engine generating units.

3.4 FIRE EXTINGUISHERS

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

END OF SECTION 011200

## SECTION 013100

### SEQUENCE OF CONSTRUCTION AND MILESTONES

#### Part 1 GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract" 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 schedule in consultation with the Department. The work must be carried out in full accordance with the schedule. The Contractor shall arrange without any unnecessary interference with the Institution's operation.

##### 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.

##### 1.4 CRITICAL ITEMS TO BE NOTED AS MILESTONES

- A. Refer to the General Conditions regarding construction progress Milestones to be established by the Lead Contractor.
- B. The Lead Contractor shall submit a construction schedule, for the total project, including all prime contractors critical path work items. The schedule shall be submitted at the pre-construction meeting. The schedule will be reviewed and approved by the designer and the using agency to confirm compliance with construction sequencing and Using Agency training schedule.

#### 1. GENERAL CONSTRUCTION (.1)

##### a. Construction Sequencing

- 1) Submittals
- 2) Mobilization
- 3) Demolition, Repairs and Initial Cleaning
- 4) Installtion of New Walls and Ceiling Joists
- 5) Installation of Drywall and New Wall Finishes
- 6) New Ceiling and Floor Finishes
- 7) Installation of New Countertop Lavatories
- 8) Installation of all New Toilet Room Accessories
- 9) Installation of New Frames, Doors and Hardware
- 10) Final Cleaning, Puch List Items, Close-Out Documents

#### 2. HVAC (.2)

##### a. Construction Sequencing

- 1) Submittals
- 2) Mobilization
- 3) Metal Ductwork
- 4) Duct Insulation
- 5) Duct Accessories
- 6) Diffusers and Grilles
- 7) Power Ventilators & Louver
- 8) Overhead fans
- 9) Instrumentation and Controls
- 10) Testing, Adjusting & Balancing
- 11) Interior Gas Lines & Valves
- 12) Exterior Gas Lines & Regulator

### 3. PLUMBING (.3)

#### a. Construction Sequencing

- 1) Submittals
- 2) Mobilization
- 3) Concrete Saw Cutting, Excavations & Installation of Sanitary Waste
- 4) Indoor Sanitary Waste and Vent Line Installation
- 5) Plumbing Fixtures Installation and Rough-Ins
- 6) Indoor Domestic Water Line installation and related Insulation
- 7) Installation of Tankless water heater
- 8) Sewage lift station
- 9) Site water and sewer forced main extensions.
- 10) Testing and Adjusting
- 11) Final Cleaning, Puch List Items, Close-Out Documents

### 4. ELECTRICAL (.4)

#### a. Construction Sequencing

- 1) Submittals
- 2) Mobilization
- 3) Panel Rough-Ins
- 4) Branch Circuit Rough-Ins
- 5) Branch Circuit Wiring
- 6) Telecom wiring and testing
- 7) Installation of Lighting
- 8) Installation of devices and outlets
- 9) Testing and Adjusting
- 10) Final Connections
- 11) Final Cleaning, Punchlist Items, and Close-Out Documentation.

END OF SECTION 013100

## SECTION 013000

### SUBMITTALS

#### Part 1 GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract" 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/CONTENT

- A. Included in this section of the specifications is a list of approvals required for all materials incorporated into the project. The Department reserves the right to require additional approvals if necessary. No material, equipment or supplies listed herein shall be incorporated into the work until the Contractor has obtained prior approval from the Department.
- B. Submittals required by each prime contract are indicated within AF Form 66 "Schedule of Material Submittals" attached to the end of Section 01300.

##### 1.3 SUBMITTAL PROCEDURES

- A. Refer to 'Submittals' of the General Conditions.
- B. Comply with the following or resubmission will be required:
  - 1. Indicate contract number, specification section and building number (as shown on the drawings) on each item submitted.
  - 2. Signify approval by stamp, initialing and dating each item prior to submission to the Professional.
- C. Items requiring testing shall be forwarded directly to the approved laboratory. The Contractor shall pay all costs associated with testing.
- D. Expedite critical materials, equipment and shop drawings, and other required submissions.
- E. Incomplete submissions will be returned for resubmission.
- F. Use of substitutions for materials or details shown on the contract drawings or called for in these specifications require written approval from the Department. See General Conditions.

##### 1.4 PRODUCT DATA

- A. Manufacturer's printed directions and manufacturer's standard specifications showing all dimensions, cuts, finishes, etc., as well as catalog cuts and ratings of all material will be required and shall be submitted in advance prior to application and/or installation.

##### 1.5 TESTS

- A. Refer to 'Tests' of the General Conditions.



- B. Submit required reports listing items tested, tests conducted and results obtained as specified.

## 1.6 CERTIFICATIONS

- A. Submit required certifications in written form identifying authorized representative, manufacturer, systems designer and other required data as specified.

## 1.7 WARRANTIES

- A. Refer to Specifications for required warranties. Copies of proposed warranties specified for products shall accompany the designated submittal of that product.

## 1.8 OPERATION AND MAINTENANCE MANUALS

- A. Manual Format (Use 3-ring binder):

1. Title page with the following information for each system covered:
  - a. Project Title and DMVA Contract Number (in capital letters)
  - b. Name of Company
  - c. Name of the individual to be called
  - d. Normal telephone numbers
  - e. Contractor's account number for project
2. Index listing all sections of the Manual.
3. Warranties for equipment furnished in contract. (Index tabbed)
4. Complete system circuit diagrams, block diagrams, copies of all approved shop drawings, which shall clearly illustrate how all the components relate and how they are interconnected and a point wiring diagram.
5. Reports, testing analysis.
6. Operating instructions and maintenance instructions for all equipment and finish materials furnished.

## 1.9 SUBMITTALS LIST

- A. See attached AF FORM 66 "Schedule of Material Submittals" organized by prime contract.

END OF SECTION 013000

**DMVA - BUREAU OF DESIGN AND PROJECT MANAGEMENT**  
**INTERNATIONAL BUILDING CODE INSPECTION LOG**

**Project Name:**

**Project Location:**

**Project Manager:**

**Phone Number:**

**Email:**

<b>REQ.</b>	<b>INSPECTION</b>	<b>NOTICE</b> (Business Days)	<b>DEPARTMENT REPRESENTATIVE (SIGNATURE)</b>	<b>DATE ACCEPTED</b>
	Demolition	72 hours		
	Footer Environment	48 hours		
	Underground Mechanical	72 hours		
	Underground Electrical	72 hours		
	Underground Plumbing	72 hours		
	Foundation	48 hours		
	Under-Slab Mechanical	72 hours		
	Under-Slab Electrical	72 hours		
	Under-Slab Plumbing	72 hours		
	Concrete Under Slab/Floor	48 hours		
	Exterior Wall Construction	48 hours		
	Mechanical Rough-In	72 hours		
	Electrical Rough-In	72 hours		
	Plumbing Rough-In	72 hours		
	Framing (Interior)	48 hours		
	Insulation (Interior)	48 hours		
	Roofing:	-		
	a) Exposed Roof Substrate	72 hours		
	b) Insulation	72 hours		
	c) Membrane	72 hours		
	d) Metal Trim & Flashing	72 hours		
	e) Gutter and Downspout	72 hours		
	f) Final Completion of Roof	72 hours		
	Fire Protection	72 hours		
	Asphalt/Concrete Paving	72 hours		
	Final - Mechanical	5 days		
	Final - Electrical	5 days		
	Final - Plumbing	5 days		
	Final - Building	5 days		
	Final - Site/Grading	5 days		
	Final - E&S Control Features	5 days		
	Final - Site Improvements	5 days		

**NO WORK MAY BE CONCEALED FROM VIEW, UNTIL THE DEPARTMENT HAS APPROVED IT.**

## INSPECTION PROCEDURES

1. **Footing Inspection:** Is to be performed after footing is dug with chairs and rods in place before concrete is poured.
2. **Underground/Overhead M.E.P Inspection:** All underground mechanical, electrical and plumbing trenching must be open and all piping, sleeves and/or conduit required for underground utilities shall be in place and provided with rodent-proofing.
3. **Foundation Inspection:** Is to be performed before framing work begins or backfill is placed. Grease traps, cleanouts, foundation and roof drains must be in place. Foundation coating must be applied, anchor bolts and top plates shall be installed. Post-pour footing inspection shall be conducted at this time and shall include verification of the depth of the footing, continuity of the footing, width of the footing and determining if the top of the footing is level.

**Note:** Foundation inspection will not be approved until the plumbing, electrical and HVAC underground work has been approved by the Department.

4. **Under-Slab M.E.P. Inspection:** Shall be performed after any/all plumbing piping, mechanical piping and electrical conduit has been placed and properly sealed and tested. Required pressure testing of plumbing and HVAC piping shall be completed prior to the Under-Slab Inspection.
5. **Under-Slab Inspection:** Is to be performed prior to the pouring of the concrete and after the base course or sub-base is properly prepared, the vapor barrier (if required) is in place and reinforcing materials such as rebar or wire mesh is properly positioned.
6. **Exterior Wall Inspection:** Is to be performed after exterior perimeter walls (concrete, CMU, steel framing, etc.) have been erected. Top plates, bracing, lintels, spray-applied vapor/moisture barriers (if required) and rigid wall insulation shall all be installed prior to the inspection being conducted. Inspection shall be performed prior to the installation of interior framing and M.E.P. rough-ins.
7. **Electrical Rough-In Inspection:** Is to be performed after the roof, framing, fire blocking and bracing are in place and all wiring and other components to be concealed are complete. This inspection is required prior to the installation of wall and ceiling finishes.
8. **Plumbing Rough-In Inspection:** Is to be performed after the roof, framing, fire-blocking, fire-stopping, draft stopping, and bracing are in place and all sanitary, storm and domestic water piping is roughed-in. This inspection is required prior to the installation of wall and ceiling finishes.
9. **Mechanical Rough-In Inspection:** Is to be performed after the roof, framing, fire-blocking and bracing are in place and all ducting and other components to be concealed are complete. This inspection is required prior to the installation of wall and ceiling finishes.
10. **Framing Inspection:** Is to be performed before insulation is installed and after all plumbing, electrical and mechanical rough-in work is completed and inspected.

**Note:** The framing may not be approved until all plumbing, electrical and HVAC rough-in work has been approved by the Department.

11. **Insulation Inspection:** Is to be performed after the framing work is approved by the Department and all insulation materials have been installed. This inspection is required prior to the installation of wall and ceiling finishes.
12. **Fire Protection Systems Inspection:** Is to be performed after fire alarm systems and/or fire suppression systems are installed and functioning. The Department has the option to accept installation and test certificates from the installing contractor(s) in lieu of witnessing the testing of fire protection systems.

13. **Final Electrical Inspection:** Is to be performed after all electrical work in the building has been completed.
14. **Final Mechanical Inspection:** Is to be performed after all HVAC work in the building has been completed.
15. **Final Plumbing Inspection:** Is to be performed after all plumbing work in the building has been completed.
16. **Final Building Inspection:** Is to be performed after all items contained within the project design documents have been completed and all prior inspections have been completed and approved. These items include, but are not limited to:
  - a. General Building:
    - Interior and Exterior Finishes
    - Roofing Materials/Flashing
    - Egress
    - Accessibility (including site)
    - Final Grading
    - Site Plan Compliance – Erosion & Sediment Control Measures
  - b. Electrical Work
  - c. Plumbing Work
  - d. Mechanical Work
  - e. Fire Protection Systems
  - f. Energy Conservation
17. **Department of Military & Veterans' Affairs (DoD) Special Inspections:** Certain facility types and specific components of the facility, may require additional inspections prior to the final acceptance of the facility by the Department. Components such as, but not limited to; weapons vaults, security monitoring, fuel distribution and/or storage, vehicle maintenance exhaust systems and secure communication rooms all may require special inspections. If not outlined within the project documents, the Department will notify contractors of any special inspections prior to the start of construction.
18. **Demolition Inspections:** Contractors responsible for demolition work where an entire structure is razed will be required to submit signed documentation that certifies that the vacant lot is filled to existing grade and that all service connections have been disconnected and properly capped. Demolition work being performed on an existing as part of renovation work or the erection of an addition may be subject to inspection by the Department. Contractors must ensure that pedestrian protective measures have been installed prior to the commencing of demolition work. Contractor shall not negatively impact existing means of egress until alternative egress routes have been established and approved.

#### NOTES

1. Contractors may not be subject to all the inspections as outlined herein. Contractors shall refer to the attached DMVA Inspection Form for all required inspections pertaining to a specific project.
2. Contractor shall contact the DMVA Project Manager and Government Design Professional prior to any and all required inspections. The DMVA Inspection Form includes required notification timeframes for each required inspection. These notifications shall be considered business days and not include weekends and/or observed Government Holidays.
3. The DMVA Inspection Procedures along with the DMVA Inspection Log, must be retained at the construction site until the completion of all work and must be made available to all Department Representatives upon request.
4. **At no time shall work of any type be concealed from view, until all required inspections have been conducted and the Department has approved it.**

SECTION 014000  
QUALITY CONTROL 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.
- B. The Contractor shall be strictly accountable for the cognizance of carrying out the provisions thereof. Contractor shall note that reference to “Project Design Documents” refers to any and all documentation included within the Project Bid and/or Award Package. This includes, but is not limited to drawings, specifications, Government forms, contractual literature, etc.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and -control services required by the Department of Military and Veterans’ Affairs or authorities having jurisdiction are not limited by provisions of this Section.
  - 4. Specific test and inspection requirements are not specified in this Section.

1.4 DEFINITIONS

- A. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual product incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities

performed by Government Design Professionals. 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.

- B. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- C. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- D. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- E. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- F. Testing Agency: An entity engaged by the contractor to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- G. Government Required Inspections: All inspections deemed necessary per the DMVA Inspection Form, will require oversight and verification by DMVA-Bureau of Design and Project Management personnel.
- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

## 1.5 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to the Government Design Professional(s) for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as

appropriate, for the context of requirements. Refer uncertainties to the Government Design Professional(s) for a decision before proceeding.

## 1.6 TESTING SUBMITTALS

- A. Schedule of Tests: Testing submittals shall include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.
  - 6. Number of tests and inspections required.
  - 7. Time schedule or time span for tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.

## 1.7 CONTRACTOR'S QUALITY-CONTROL PLAN


- A. Quality-Control Plan, General: Submit quality-control plan within ten (10) days of Notice to Proceed, and not less than five (5) days prior to preconstruction conference. Submit in format acceptable to Government Design Professional. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
  - 1. Project quality-control manager may also serve as Project superintendent.
- C. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
  - 1. Contractor-performed tests including subcontractor-performed tests. Include required tests and inspections and Contractor-elected tests and inspections.
- D. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- E. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Government Design Professional and/or Project Manager has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

## 1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
  2. Project title and number.
  3. Name, address, and telephone number of testing agency.
  4. Dates and locations of samples and tests or inspections.
  5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and re-inspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representatives making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Government's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.



## 1.9 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B.  Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work 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.
- E. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- F. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
  - 1. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Government Design Professional, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

## 1.10 QUALITY CONTROL

- A. Government Responsibilities: Where quality-control services are indicated as Government's responsibility, the Government will engage qualified Government personnel and/or an independent testing agency to perform these services.
  - 1. Government will furnish Contractor with names, addresses, and telephone numbers of personnel or testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
- B. Contractor Responsibilities: All testing requirements outlined within the Project Design Documents and/or requested by the Government Project Representatives, are to be the Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
  - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

- a. Contractor shall not employ same entity engaged by the Government, unless agreed to in writing by Government.
  - 2. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  - 3. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 4. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
  - D. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
  - E. **Retesting/Re-inspecting:** Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction work that failed to comply with the Contract Documents.
  - F. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
    - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

#### 1.11 TESTS AND INSPECTION PROCEDURES

- A. **Required Tests:** Contractors shall refer to the Project Specifications for all testing requirements pertaining to individual aspects of the project.
- B. **Notification of Inspections and Tests:** Contractor shall notify the DMVA-BDPM Project Manager of a required or specified inspection and/or inform them of an upcoming test. Contractor shall refer to the DMVA Inspection Log for the required allowance of notification (in business days) for requesting inspections and/or observations of tests.
  - 1. Notification of required inspections or tests shall not be less than 48 hours prior to the inspection and/or test. Weekends and Observed Government Holidays shall not be factored into notifications and are not considered as business days.
- C. Upon the completion of an inspection or test. The Government Design Professional or Project Manager will approve or dis-approve the work in question and sign and date the Inspection Log within forty-eight (48) hours of the test or inspection being completed.

- D. At no time shall any work of any type outlined within the DMVA Inspection Log be covered-up or concealed from view until all required inspections and/or tests have been conducted and the Department has approved it.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials that comply with installation requirements specified in corresponding Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams, that show no visible signs of damage or repair.
- B. Protect construction exposed by or for quality-control service activities.
- C. In the event of work being deemed unacceptable due to poor workmanship, code violations, failure to meet design intent or following of the design documents, etc., corrective actions will be provided to the contractor along with a timeframe in which the contractor will have to complete the corrective actions. Communication to the contractor(s) regarding corrective actions will be in the form of meeting minute comments and/or formal (email or written) correspondence provided by the Government Contracting Office.
- D. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.
- E. Failure of the contractor to correct work of any type deemed to be unacceptable, could result in the Government taking actions as outlined within the Project General Conditions.

END OF SECTION 014000

SECTION 017700  
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Additional Division 1 Specifications and Contractual Requirements included within the Project Package per the PA Department of Military and Veteran's Purchasing Department and/or the United States Fiscal and Property Office's Purchasing and Contracting Division.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Inspection procedures.
  - 2. Warranties.
  - 3. Final cleaning.
- B. Related Sections include the following:
  - 1. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 3. Divisions 2 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION (BENEFICIAL OCCUPANCY)

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 3. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction, damage or settlement surveys, property surveys, and similar final record information.
  - 4. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  - 5. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  - 6. Complete startup testing of systems.

7. Submit test/adjust/balance records.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Advise Owner of changeover in heat and other utilities.
10. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
11. Complete final cleaning requirements, including touchup painting.
12. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Government Design Professional and Government Project Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. The Contracting Officer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Design Professional and/or Inspector, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

#### 1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to the Government Contracting Office's "Payment Procedures."
2. Submit certified copy of Government Design Professional's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by the Design Professional. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Government Design Professional and Government Project Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. The Contracting Officer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first then proceeding on the interior from the Main Entrance clockwise throughout the facility.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
  - a. Project name.
  - b. Date
  - c. Name of Contractor.
  - d. Page number.

## 1.6 WARRANTIES

- A. Submittal Time: Submit written warranties on request of the Government Design Professional (per FORM 66's) for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents within the Project Operation and Maintenance Manuals.

## PART 2 - EXECUTION

### 2.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.
    - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.

- i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
  - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
  - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - n. Replace parts subject to unusual operating conditions.
  - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
  - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
  - s. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

## PART 3 - PRODUCTS

### 3.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

END OF SECTION 017700

SECTION 017823

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Additional Division 1 Specifications and Contractual Requirements included within the Project Package per the PA Department of Military and Veteran's Purchasing Department and or United States Fiscal and Property Office's Purchasing and Contracting Division.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Emergency manuals.
  - 3. Operation manuals for systems, sub-systems, and equipment.
  - 4. Maintenance manuals for the care and maintenance of products, materials, finishes, systems and equipment.
- B. Related Sections include the following:
  - 1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
  - 2. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
  - 3. Divisions 2 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

- A. Pre-Final Submittal: Submit one (1) hard copy of each manual in final form at least 14 days before final inspection. Government Design Professional will return copy with comments within 7 days after final inspection.
  - 1. Correct or modify each manual to comply with Architect's comments. Submit one (1) hard copy and two (2) electronic (Adobe PDF Format) copies of each corrected manual within 14 days of receipt of Government Design Professional's comments.



## 1.5 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

### PART 2 - PRODUCTS

## 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
  - 1. List of documents.
  - 2. List of systems.
  - 3. List of equipment.
  - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

## 2.2 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Date of submittal.
  - 4. Name, address, and telephone number of Contractor.
  - 5. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents per CSI Specifications (Divisions 02-33). Within each organize each Division by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
  2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
  4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
  5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## 2.3 EMERGENCY INFORMATION

- A. Content: Organize into a separate section for each of the following:
1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
  2. Flood.
  3. Gas leak.
  4. Water leak.
  5. Power failure.

6. Water outage.
  7. System, subsystem, or equipment failure.
  8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
  2. Shutdown instructions for each type of emergency.
  3. Operating instructions for conditions outside normal operating limits.
  4. Required sequences for electric or electronic systems.
  5. Special operating instructions and procedures.

## 2.4 OPERATION INFORMATION

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.
  2. Operating standards.
  3. Operating procedures.
  4. Operating logs.
  5. Wiring diagrams.
  6. Control diagrams.
  7. Piped system diagrams.
  8. Precautions against improper use.
  9. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.

- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

## 2.5 PRODUCT MAINTENANCE

- A. Content: Organize into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

## 2.6 SYSTEMS AND EQUIPMENT MAINTENANCE INFORMATION

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed maintenance instructions and bulletins.
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

### PART 3 - EXECUTION

#### 3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance information.
- B. Emergency Information: Compile complete documentation of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Information: Compile complete documentation of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Information: Compile complete documentation of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of

equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
1. Do not use original Project Record Documents as part of operation and maintenance manuals.
  2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."

END OF SECTION 017823

SECTION 017839  
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Additional Division 1 Specifications and Contractual Requirements included within the Project Package per the PA Department of Military and Veteran's Purchasing Department and or United States Fiscal and Property Office's Purchasing and Contracting Division.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings in CAD Format.
  - 2. Record Specifications.
  - 3. Record Product Data.
  - 4. Project Cost Analysis
- B. Related Sections include the following:
  - 1. Division 1 Section "Closeout Procedures" for general closeout procedures.
  - 2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 3. Divisions 2 through 33 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. One (1) Hard Copy of Contractor As-Built Drawings. Minimum Drawing Size to be 24"x36".
  - 2. One (1) CD Rom containing CAD based Contractor As-Built Drawings.
- B. Record Product Data: Submit as part of the Project Operation and Maintenance Manuals.
- C. Project Cost Analysis: To be submitted when the Owner takes Beneficial Occupancy.

PART 2 - PRODUCTS

## 2.1 RECORD DRAWINGS

- A. Record Prints: Contractor to maintain one (1) red-lined set of drawings throughout the duration of the project construction phase. Prior to the substantial completion, contractor shall transfer all red-lined mark-ups to the Government provided CAD drawings.
1. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations below first floor.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or No Cost Field Change.
    - k. Changes made following Government Design Professional's written orders.
    - l. Field records for variable and concealed conditions.
- B. Preparation: Contractor to transfer all construction red-line mark-ups from the record set onto the Government provided CAD drawings. Government drawings are AutoDesk (AutoCad) format and this format shall be maintained by the contractor.
1. Contractor to create a CAD layer within each Government provided CAD drawing and label it;  
"CONTR\_AS-BUILTS"  
Note: All contractor related As-Built changes shall be contained to this layer.
- C. Record Plans: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Government Design Professional and/or Government Project Manager. When authorized, prepare a full set of corrected transparencies of the Contract Drawings and Shop Drawings.
1. Refer instances of uncertainty to the Government Design Professional for resolution.
- D. Format:
1. Record Prints: Contractor shall plot one (1) 24"x36" (min.) set of As-Built drawings to submit for review. As-Built set shall be organized and binded per the DMVA-BDPM Cover Sheet. Hardcopy set should contain an "AS-BUILT" stamp located in the lower right-hand corner of each sheet.
  2. AutoDesk (AutoCad) Format, Release 2018 (or newer).

## 2.2 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.



1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Specifications and Record Drawings where applicable.

## 2.3 PROJECT COST ANALYSIS

- A. Preparation: Contractor shall maintain construction cost throughout the duration of the project. The following cost shall be submitted upon the Owner taking Beneficial Occupancy of the facility.
- B. Building Cost: Overall renovation cost of the facility, excluding all site utilities. Cost shall incorporate all Change Order amounts into this breakout.
- C. Site Utilities: Contractor shall provide an updated cost and total linear footage for the following site utility installations:
  1. Domestic Water
  2. Sanitary Sewer
  3. Electrical Service
  4. Gas/Propane Service

## 2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submit in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

## PART 3 - EXECUTION

### 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Government Design Professional, Government Project Manager and/or Contracting Officer's reference during normal working hours.

END OF SECTION 017839

SECTION 024119  
SELECTIVE DEMOLITION

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

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 the Department.
- C. 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 SUBMITTALS

- A. Make submissions in accordance with Division 1 Specifications and ‘SCHEDULE OF MATERIAL SUBMITTALS’, attached at the end of the Specifications.
- B. No deviations, substitutions, or changes of materials, to be incorporated into this project, shall be made after approval by the Department, except for written direction by and the approval of the manufacturer of a specific item and re-approval by the Department.
- C. The Department retains the right to require additional items not specifically denoted to be submitted for approval and/or additional clarification.

1.5 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in demolition operations and who are completely familiar with the specified requirements and methods needed for the proper performance of the work.

- B. Use equipment adequate in size, capacity and number to accomplish the work in a safe and timely manner.
- C. All work shall be performed in complete compliance with the rules and regulations of the Federal Department of Labor, Occupational Safety and Health Administration.

#### 1.6 FIELD CONDITIONS

- A. The Contractor shall beware of the fact that all Drawings provided for this project are diagrammatic in nature and require field verification for actual site conditions that will affect project execution, exact quantities, and details.
  - 1. Cutting and removals depicted on the Drawings are a general indication only of the work required and do not necessarily show the full extent and/or limit the Contractor's responsibility to perform any such work required to properly execute this Contract.
- B. Notify the Design Professional of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify the Design Professional and Using Agency. Hazardous materials will be removed by Owner under a separate contract.
- D. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

#### 1.7 JOB CONDITIONS

- A. Prior to the start of demolition, the General Contractor shall provide the following:
  - 1. Provide safety barriers, taped isolation areas, warning lights and/or other protective devices, as required.
- B. Do not close or obstruct egress for any building exit.
- C. Perform work in a manner to prevent damage or injury to military personnel and/or property to the public.
- D. Conduct demolition to minimize interference with adjacent and occupied building areas.
- E. Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to the Using Agency.
- F. Protect walls, ceilings, floors, and other existing areas/items that are to remain and are exposed during demolition operations.
- G. Use caution and wear appropriate clothing, including gloves and safety goggles.

## 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. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. 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 the Design Professional.

### 3.2 PREPARATION

- A. Thoroughly review all Drawings and Specification and coordinate demolition operations with all trades.
- B. 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.
- C. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- D. 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.

### 3.3 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. 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.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. 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.
4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

- B. Surveys: During demolition, perform surveys to detect hazards that may result from building demolition activities.

### 3.4 SELECTIVE DEMOLITION

- A. All demolition work shall be executed in such a manner as to prevent any damage to the adjacent existing work/conditions.

1. Prior to demolition of each item the Contractor shall inspect the adjacent conditions and report any pre-existing damaged areas to the Design Professional for verification. Pre-existing damage SHALL NOT be the responsibility of the Contractor to repair if previously identified.

- B. Demolition operations SHALL NOT start until all shop drawings have been approved.

### 3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. The Department retains the right of first refusal of all demolished items. All items not retained by the Department shall be removed from the site unless stated otherwise within this specification and transported to its final disposal location in a manner that prevents spillage on streets, roadways, or adjacent areas. All cleanup and disposal shall be in accordance with local, state and federal laws and regulations. In cases of conflict among these laws and regulations, the most stringent law or regulation shall apply.

- B. Contractor shall recycle demolished concrete, asphalt and fencing materials, provided that there is a recognized Recycling Center within a 25-mile radius of the project site. If a Recycling Center is not available disposal shall be at a PA DEP approved landfill.

1. Provide name and address of the Recycling Center and/or landfill to be utilized for disposal of demolished material.
2. Provide original weight slips from the above facility to verify compliance with this requirement.
3. Assumed salvage value of recycled materials, if any, may be reflected in the Contract Proposal at the Contractors option.
4. Cost of transportation of demolished material shall be included with the Contract Price.

- C. Demolition materials/items shall be gathered daily and neatly stored in a location designated by the Using Agency until off-site disposal.

- D. Drives and walkways adjacent to the work area shall be always kept clear of obstructions; areas shall be clean and clear of materials and debris to their full length and width and shall be maintained in a manner so as to permit safe and normal use.
- E. The Contractor shall be responsible for the safe and orderly transport of demolition from the work site.

### 3.6 RESTORATION

- A. Repair or replace damaged adjacent areas, which were not identified during pre-demolition inspection required under paragraph 3.b., this PART, with like materials, to the Departments satisfaction.
- B. The Contractor shall repair or replace all damage to ground areas (paved, stone, and grass) that have been damaged during demolition and/or construction operations. Contractor shall repair/replace all damage to adjacent buildings that have been damaged during demolition and/or construction operations. Like materials shall be used to repair/replace damaged items/areas to original condition; and shall be to the Government's satisfaction.

### 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

SECTION 024120  
CUTTING AND PATCHING

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 the reference thereto and shall have the same force and effect as printed herewith in full.

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
  - 1. Division 02 Section "Selective Demolition" for demolition of selected portions of the building.
  - 2. Divisions 02 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 5 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
  - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
  - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
  - 3. Products: List products to be used and firms or entities that will perform the Work.
  - 4. Dates: Indicate when cutting and patching will be performed.
  - 5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
  - 6. Facility Construction Maintenance Manager's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

## 1.5 QUALITY ASSURANCE

- A. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, which results in reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:
  - 1. Equipment supports.
  - 2. Piping.
- B. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Government Design Professional's opinion, reduce the building's aesthetic qualities.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually fully match in-place adjacent surfaces possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting, and patching are to be performed.
  - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
  - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.



### 3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
  
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 5. Proceed with patching after construction operations requiring cutting are complete.
  
- C. Patching: Patch construction by filling, repairing, refinishing, closing, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  - 4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather-tight condition.
  
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 024120

SECTION 040120  
BRICK MASONRY REPAIR

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. Repairing brick masonry, including replacing units.
  - 2. Removing abandoned anchors.
  - 3. Painting steel uncovered during the work.

1.3 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.
- B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.
- C. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of masonry units to freezing and thawing.

1.4 SEQUENCING AND SCHEDULING

- A. Work Sequence: Perform brick masonry repair work in the following sequence, which includes work specified in this and other Sections:
  - 1. Remove plant growth.
  - 2. Inspect masonry for open mortar joints and point them before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
  - 3. Remove paint.
  - 4. Clean masonry.
  - 5. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
  - 6. Repair masonry, including replacing existing masonry with new masonry materials.
  - 7. Rake out mortar from joints to be repointed.
  - 8. Point mortar and sealant joints.
  - 9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
  - 10. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.

- B. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to "Masonry Unit Patching" Article. Patch holes in mortar joints according to Section 040120.64 "Brick Masonry Repointing."

#### 1.5 ACTION SUBMITTALS

- A. Samples for Verification: For the following:
  - 1. Each type of brick unit to be used for replacing existing units. Include sets of Samples to show the full range of shape, color, and texture to be expected. For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.
  - 2. Each type of patching compound in the form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For brick masonry repair specialist.

#### 1.7 QUALITY ASSURANCE

- A. Brick Masonry Repair Specialist Qualifications: Engage an experienced brick masonry repair 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 in only installing masonry is insufficient experience for masonry repair work.
  - 1. Field Supervision: Brick masonry repair specialist firm shall maintain experienced full-time supervisors on Project site during times that brick masonry repair work is in progress.
  - 2. Brick Masonry Repair Worker Qualifications: When masonry units are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.
- 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.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons and protected against impact and chipping.
- B. Deliver packaged 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.
- D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.
- E. Store sand where grading and other required characteristics can be maintained, and contamination avoided.
- F. Handle masonry units to prevent overstressing, chipping, defacement, and other damage.

## 1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit brick masonry repair work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Temperature Limits, General: Repair masonry units only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.
- C. Cold-Weather Requirements: Comply with the following procedures for masonry repair unless otherwise indicated:
  - 1. When air temperature is below 40 deg F, heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F.
  - 2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for seven days after repair.
- D. Hot-Weather Requirements: Protect masonry repairs 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 and above unless otherwise indicated.
- E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain each type of material for repairing brick masonry (brick, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

### 2.2 MASONRY MATERIALS

- A. Face Brick: As required to complete brick masonry repair work.
  - 1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork and with physical properties within 10 percent of those determined from preconstruction testing of selected existing units.
    - a. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.
  - 2. Special Shapes:
    - a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position and where shapes produced by sawing would result in sawed surfaces being exposed to view.
    - b. Provide specially ground units, shaped to match patterns, for arches and where indicated.
    - c. Mechanical chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.
- B. Building Brick: ASTM C 62, of same vertical dimension as face brick, for masonry work concealed from view.
  - 1. Grade SW where in contact with earth.

2. Grade SW or MW for concealed backup.

## 2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of 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. Masonry Cement: ASTM C 91/C 91M.
  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. Cemex S.A.B. de C.V.; Richmortar Type M.
    - b. Lehigh Hanson, Inc.; Lehigh Masonry Cement and/or Lehigh White Masonry Cement.
    - c. Quikrete Companies, Inc. (The); Quikrete Masonry Cement.
    - d. "Or Approved Equal"
- D. Mortar Cement: ASTM C 1329/C 1329M.
  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. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.
    - b. "Or Approved Equal".
- E. Mortar Sand: ASTM C 144.
  1. Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
  2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
- F. Mortar Pigments: ASTM C 979/C 979M, compounded for use in mortar mixes, and having a record of
  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. Davis Colors, Inc.; True Tone Mortar Colors.
    - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
    - c. Solomon Colors, Inc.; SGS Mortar Colors.
    - d. "Or Approved Equal"
- G. Water: Potable.

## 2.4 MANUFACTURED REPAIR MATERIALS

- A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.
  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. Cathedral Stone Products, Inc.; Jahn M100 Terra Cotta and Brick Repair Mortar.
    - b. Conproco Corporation; Mimic or Matrix.
    - c. Edison Coatings, Inc.; Custom System 45 or Thin-Fill 55.
    - d. "Or Approved Equal"

2. Use formulation that is vapor and water permeable (equal to or more than the masonry unit), exhibits low shrinkage, has lower modulus of elasticity than masonry units being repaired, and develops high bond strength to all types of masonry.
3. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
4. Formulate patching compound in colors and textures to match each masonry unit being patched. Provide no fewer than three colors to enable matching of the color, texture, and variation of each unit.

## 2.5 ACCESSORY MATERIALS

- A. Setting Buttons and Shims: Resilient plastic, non-staining to masonry, sized to suit joint thicknesses and bed depths of masonry units, less the required depth of pointing materials unless removed before pointing.
- B. Masking Tape: Non-staining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.
- C. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.
  1. Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning" SSPC-SP 3, "Power Tool Cleaning" or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" surface preparation according to manufacturer's literature or certified statement.
  2. VOC Limit: Use coating with a VOC content of 400 g/L or less.
- D. Other 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. Minimal 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 leave residue on surfaces.

## 2.6 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.
- B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
  1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.
- C. Do not use admixtures in mortar unless otherwise indicated.
- D. Mixes: Mix mortar materials in the following proportions:
  1. Rebuilding (Setting) Mortar by Volume: ASTM C 270, Proportion Specification, 1 part portland cement, 1 part lime, and 6 parts sand.
  2. Rebuilding (Setting) Mortar by Type: ASTM C 270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to masonry cement or mortar cement.

3. Rebuilding (Setting) Mortar by Property: ASTM C 270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to masonry cement or mortar cement.
4. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

### PART 3 - EXECUTION

#### 3.1 PROTECTION

- A. Prevent mortar from staining face of surrounding masonry and other surfaces.
  1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
  2. Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.
  3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.
- B. Remove gutters and downspouts and associated hardware adjacent to masonry and store during masonry repair. Reinstall when repairs are complete.
  1. Provide temporary rain drainage during work to direct water away from building.

#### 3.2 MASONRY REPAIR, GENERAL

- A. Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 20 feet away by Government Design Professional and/or Government Representative.

#### 3.3 ABANDONED ANCHOR REMOVAL

- A. Remove abandoned anchors, brackets, wood nailers, and other extraneous items no longer in use unless indicated to remain.
  1. Remove items carefully to avoid spalling or cracking masonry.
  2. Notify Government Design Professional before proceeding if an item cannot be removed without damaging surrounding masonry. Do the following where directed:
    - a. Cut or grind off item approximately 3/4 inch beneath surface and core drill a recess of same depth in surrounding masonry as close around item as practical.
    - b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.
  3. Patch hole where each item was removed unless directed to remove and replace masonry unit.

#### 3.4 BRICK REMOVAL AND REPLACEMENT

- A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
  1. When removing single bricks, remove material from center of brick and work toward outside edges.
- B. Support and protect remaining masonry that surrounds removal area.
- C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

- D. Notify Government Design Professional and DGS Construction Manager of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.
- E. Remove in an undamaged condition as many whole bricks as possible.
  - 1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
  - 2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
  - 3. Store brick for reuse. Store off ground, on skids, and protected from weather.
  - 4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.
- F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.
- G. Replace removed damaged brick with other removed brick in good condition, where possible, or with new brick matching existing brick. Do not use broken units unless they can be cut to usable size.
- H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
  - 1. Maintain joint width for replacement units to match existing joints.
  - 2. Use setting buttons or shims to set units accurately spaced with uniform joints.
- I. Lay replacement brick with rebuilding (setting) mortar and with filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. Use wetting methods that ensure that units are nearly saturated, but surface is dry when laid.
  - 1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
  - 2. Rake out mortar used for laying brick before mortar sets according to Section 040120.64 "Brick Masonry Repointing." Point at same time as repointing of surrounding area.
  - 3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.
- J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
  - 1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

### 3.5 PAINTING STEEL UNCOVERED DURING THE WORK

- A. Notify Architect if steel is exposed during masonry removal. Where Architect determines that steel is structural, or for other reasons cannot be totally removed, prepare, and paint it as follows:
  - 1. Surface Preparation: Remove paint, rust, and other contaminants according to SSPC-SP 3, "Power Tool Cleaning" or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning", as applicable to comply with paint manufacturer's recommended preparation.
  - 2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).
- B. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch, notify Government Design Professional and/or On-Site Government Inspector before proceeding.



### 3.6 MASONRY UNIT PATCHING

- A. Patch the following masonry units unless another type of repair or replacement is indicated:
  - 1. Units indicated to be patched.
  - 2. Units with holes.
  - 3. Units with chipped edges or corners. Patch chipped edges or corners measuring more than 3/4 inch in least dimension.
  - 4. Units with small areas of deep deterioration. Patch deep deteriorations measuring more than 3/4 inch in least dimension and more than 1/4 inch deep.
- B. Remove and replace existing patches unless otherwise indicated or approved by Government Design Professional.
- C. Patching Bricks:
  - 1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch thick, but not less than recommended in writing by patching compound manufacturer.
  - 2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of masonry unit.
  - 3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
  - 4. Rinse surface to be patched and leave damp, but without standing water.
  - 5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
  - 6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.
  - 7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of masonry unit. Shape and finish surface before or after curing, as determined by testing, to best match existing masonry unit.
  - 8. Keep each layer damp for 72 hours or until patching compound has set.
  - 9. Remove and replace patches with hairline cracks or that show separation from brick at edges, and those that do not match adjoining brick in color or texture.

### 3.7 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.
  - 1. Do not use metal scrapers or brushes.
  - 2. Do not use acidic or alkaline cleaners.
- B. Clean adjacent non-masonry 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. Remove masking materials, leaving no residues that could trap dirt.

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

- B. Government Project Manager: DMVA-BDPM will assign a Government Project Manager to help carry out Government Design Professional's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Government Project Manager use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.
- C. Notify independent inspectors and Government Project Manager in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors and Government Project Manager have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

### 3.9 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.
- B. Masonry Waste: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION 040120

SECTION 054000  
LOAD BEARING METAL FRAMING

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:
  - 1. Load-bearing ceiling framing.
  - 2. Load-bearing wall framing

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed as detailed herein and capable of withstanding local conditions as dictated by all governing building codes.
- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
  - 1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."

1.4 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Shop Drawings: Show layout, spacing's, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
  - 1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
  - 1. Steel sheet.

2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research/Evaluation Reports: For cold-formed metal framing.

## 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.
- C. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
  1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
  1. Allied Studco.
  2. AllSteel Products, Inc.
  3. Dietrich Metal Framing; a Worthington Industries Company.
  4. United Metal Products, Inc.

5. Or Approved Equal

2.2 MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated.

2.3 LOAD-BEARING WALL FRAMING

- A. Steel Ceiling Joist: Manufacturer's standard C-shaped steel Joist, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 14 ga.
  - 2. Flange Width: 1-5/8 inches
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 14 ga.
  - 2. Flange Width: 1-5/8 inches.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 14 ga.
  - 2. Flange Width: 1-5/8 inches.
- D. Steel Wall Stud: Manufacturer's standard C-shaped steel Joist, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 18 ga.
  - 2. Flange Width: 1-5/8 inches

2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  - 1. Supplementary framing.
  - 2. Bracing, bridging, and solid blocking.
  - 3. Web stiffeners.
  - 4. Anchor clips.
  - 5. End clips.

6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

## 2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel and carbon-steel nuts; and flat, hardened-steel washers; zinc coated.
- C. 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 per ASTM E 488 conducted by a qualified independent testing agency.
- D. 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 per ASTM E 1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
  1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

## 2.6 MISCELLANEOUS MATERIALS

- A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

## 2.7 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Fabricate framing assemblies using jigs or templates.
  - 2. Cut framing members by sawing or shearing; do not torch cut.
  - 3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
  - 4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
  - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

### 3.2 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

- B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.3 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:



1. Anchor Spacing: To match stud spacing.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
  1. Stud Spacing: 16 inches.
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
  1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
  2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
  1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced 48 inches. Fasten at each stud intersection.
  1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.
  2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

#### 3.4 FIELD QUALITY CONTROL

- A. Testing: Contractor shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Government Design Professional.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

#### 3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055213  
PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications “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 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. Section Includes:
  - 1. Steel pipe railings.

1.4 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.
- B. Coordinate installation of anchorages for railings. 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.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Railing brackets.
  - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
  - a. Show method of connecting and finishing members at intersections.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- C. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- D. Evaluation Reports: For post-installed anchors, from ICC-ES.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

#### 1.8 FIELD CONDITIONS

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

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Steel Pipe and Tube Railings:
  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. Wagner, R & B, Inc.
    - b. "Or Approved Equal"
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.

## 2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  - 1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

## 2.4 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- E. Expanded Metal: ASTM F 1267, Type I (expanded), Class 1 (uncoated).
- F. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch woven-wire mesh, made from 0.134-inch-diameter wire complying with ASTM A 510.

## 2.5 FASTENERS

- A. General: Provide the following:
  - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
  - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
  - 3. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
  - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
  - 2. Provide Phillips or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

## 2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- F. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

- G. Intermediate Coats and Topcoats: Provide products that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- H. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- I. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- J. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- K. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

## 2.7 FABRICATION

- 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. Shop assemble railings 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 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. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.
- H. 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.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

- J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
  - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- K. Form Changes in Direction as Follows:
  - 1. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
- L. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- M. Close exposed ends of railing members with prefabricated end fittings.
- N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- Q. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- R. For removable railing posts, fabricate slip-fit sockets from stainless-steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
  - 1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- S. Expanded-Metal Infill Panels: Fabricate infill panels from expanded metal made from same metal as railings in which they are installed.
  - 1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than 0.043 inch thick.
  - 2. Orient expanded metal with long dimension of diamonds parallel to top rail.
- T. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from same metal as railings in which they are installed.
  - 1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch thick.
  - 2. Orient perforated metal with pattern parallel to top rail.



- U. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch 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.
- V. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

## 2.8 STEEL AND IRON FINISHES

- A. Galvanized Railings:
  - 1. Hot-dip galvanized indicated steel railings, including hardware, after fabrication.
  - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
  - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
  - 4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
  - 5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
  - 1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
  - 1. Shop prime uncoated railings with universal shop primer unless indicated.
  - 2. Do not apply primer to galvanized surfaces.
- G. Shop-Painted Finish: Color: As selected by Government Design Professional from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

### 3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

### 3.4 ANCHORING POSTS

- A. Cover anchorage joint with flange of same metal as post, attached to post with set screws.
- B. Leave anchorage joint exposed with anchoring material flush with adjacent surface.

- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
  - 2. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
  - 3. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

### 3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.
- C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  - 2. For hollow masonry anchorage, use toggle bolts.
  - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
  - 4. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
  - 5. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

### 3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting,"
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

### 3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 061053  
MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Wood blocking, cants, and nailers.

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
- B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

## 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.

### 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- B. Application: Treat all miscellaneous carpentry, unless otherwise indicated.
  - 1. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

### 2.3 DIMENSION LUMBER FRAMING

- A. Maximum Moisture Content: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness.
- B. Other Framing: Construction or No. 2 grade and the following species:

### 2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Cants.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.
- C. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content.
- D. For exposed boards, provide lumber with 19 percent maximum moisture content.
- E. 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.
- F. 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.

## 2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
  - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: NES NER-272.
- C. Wood Screws: ASME B18.6.1.
- D. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. 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.

## 2.6 METAL FRAMING ANCHORS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
  - 1. Use for interior locations where stainless steel is not indicated.

## 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. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated
- C. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.
- D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- 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. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- G. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

### 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 rough carpentry from weather. If, despite protection, 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 079200  
JOINT SEALANTS

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 joint sealants for the following applications:
1. Exterior joints in the following vertical surfaces and horizontal non-traffic surfaces:
    - a. Control and expansion joints in unit masonry.
    - b. Joints between metal panels.
    - c. Joints between different materials listed above.
    - d. Perimeter joints between materials listed above and frames of doors and windows.
    - e. Other joints as indicated.
  2. Exterior joints in the following horizontal traffic surfaces:
    - a. Tile control and expansion joints.
    - b. Other joints as indicated.
  3. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints of exterior openings where indicated.
    - c. Tile control and expansion joints.
    - d. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - e. Other joints as indicated.
  4. Interior joints in the following horizontal traffic surfaces:
    - a. Control and expansion joints in tile flooring.
    - b. Other joints as indicated.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

#### 1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Warranties: Special warranties specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

#### 1.6 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.
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

#### 1.7 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two (2) years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Five (5) years from date of Substantial Completion.
- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
  - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
  - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## 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 sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that 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.
- C. Colors of Exposed Joint Sealants: As indicated by manufacturer's designations.

### 2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

Stain-Test-Response Characteristics: Where elastomeric 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.
- B. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- C. Multicomponent Pourable Neutral-Curing Silicone Sealant:
  - 1. Type and Grade: M (multicomponent) and P (pourable).
  - 2. Class: 25.
  - 3. Uses Related to Exposure: T (traffic) and NT (non-traffic).
  - 4. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
    - a. Use O Joint Substrates: Galvanized steel.
- D. Single-Component Pourable Neutral-Curing Silicone Sealant:
  - 1. Type and Grade: S (single component) and P (pourable).
  - 2. Class: 100/50.
  - 3. Uses Related to Exposure: NT and T (traffic).
  - 4. Uses Related to Joint Substrates: M A and O, as applicable to joint substrates indicated.
    - a. Use O Joint Substrates: Galvanized steel.
- E. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:

1. Type and Grade: S (single component) and NS (non-sag).
2. Class: 25.
3. Use Related to Exposure: NT (non-traffic).
4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
  - a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel and ceramic tile.

F. Multicomponent Pourable Urethane Sealant:

1. Type and Grade: M (multicomponent) and P (pourable).
2. Class: 25.
3. Use Related to Exposure: T (traffic).
4. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
  - a. Use O Joint Substrates: Ceramic tile.

G. Multicomponent Pourable Urethane Sealant:

1. Type and Grade: M (multicomponent) and P (pourable).
2. Class: 25.
3. Uses Related to Exposure: T (traffic) and NT (non-traffic).
4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
  - a. Use O Joint Substrates: Color anodic aluminum and aluminum coated with a high-performance coating.

## 2.3 SOLVENT-RELEASE JOINT SEALANTS

- A. Butyl-Rubber-Based Solvent-Release Joint Sealant: Comply with ASTM C 1085.
- B. Pigmented Narrow-Joint Sealant: Manufacturer's standard, solvent-release-curing, pigmented, synthetic-rubber sealant complying with AAMA 803.3 and formulated for sealing joints 3/16 inch or smaller in width.

## 2.4 PREFORMED JOINT SEALANTS

- A. Preformed Silicone-Sealant System: Manufacturer's standard system consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.
- B. Preformed Foam Sealant: Manufacturer's standard preformed, pre-compressed, open-cell foam sealant that is manufactured from high-density urethane foam impregnated with a nondrying, water-repellent agent; is factory produced in pre-compressed sizes in roll or stick form to fit joint widths indicated; is coated on one side with a pressure-sensitive adhesive and covered with protective wrapping; develops a watertight and airtight seal when compressed to the degree specified by manufacturer; and complies with the following:

1. Properties: Permanently elastic, mildew resistant, non-migratory, non-staining, and compatible with joint substrates and other joint sealants.

a. Density: Manufacturer's standard.

## 2.5 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type 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. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to 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 where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.6 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, blast cleaning, 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 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 in writing by joint-sealant manufacturer, based on 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 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 type 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. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
  - 1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
  - 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
  - 3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
  - 4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
  
- G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

### 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.

END OF SECTION

SECTION 081113

HOLLOW METAL DOORS AND FRAMES

PART 1 – GENERAL

1.1 STIPULATIONS

- A. The General Conditions, Drawings and any other attached Contract Documents form a part of this Section by reference thereto and shall have the same force and effect as if printed herewith in full. The Contractor shall be strictly accountable for the cognizance of carrying out the provisions thereof.

1.2 SCOPE OF WORK OUTLINE

- A. The work under this Section shall generally consist of, but not necessarily be limited to, providing all labor, material, devices and equipment required for installation of:
  - 1. Hollow Metal Doors and Frames
- B. All work under this section shall be in compliance with other trades and sections of this Specification.

1.3 REFERENCES/ACRONYMS

- A. The following referenced material shall apply to this specification and have the same force and effect as if printed in full herein. All reference material shall be the latest published edition, unless otherwise noted:

- 1. SDI = Steel Door Institute (latest edition)
- 2. ASTM = American Society for Testing and Materials (latest edition)
- 3. ANSI = American National Standards Institute
- 4. BHMA = Builders Hardware Manufacturers Association
- 5. DHI = Door Hardware Institute

SDI-105-91	Recommended Erection Instructions for Steel Frames.
SDI-100-1991	Recommended Specifications: Standard Steel Doors and Frames.
ASTM A 366	Specifications for Steel Sheet, Carbon, Cold Rolled, Commercial
ASTM B 117	Standard Practice for Operating Salt Spray Apparatus
ASTM D 1735	Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
ANSI A 115	Specification for Door and Frame Preparation for Hardware
BHMA A156	Door Finish Hardware
BHMA A156.7	Template Hinge Dimensions

DHI-05 Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames

1.4 SUBMITTALS



- A. Make submissions in accordance with 'SCHEDULE OF MATERIAL SUBMITTALS', attached at end of the Specifications.
- B. No deviations, substitutions or changes of materials, to be incorporated into this project, shall be made after approval by the Government, except for written direction by and the approval of the manufacturer of a specific item and re-approval by the Government.
- C. The Government retains the right to require additional items not specifically denoted, to be submitted for approval and/or additional clarification.

#### 1.5 QUALITY ASSURANCE

- A. All materials under this Section shall be factory certified, first run material. Seconds will not be permitted.
- B. Materials shall be compatible in every way, with all other components. Substitutions will not be permitted after approved descriptive data and/or shop drawings have been acted upon and distributed.
- C. Unless otherwise specified doors and frames, under this Section, shall be the product of a single manufacturer.
- D. Also see Removal of Non-Compliant Materials, this PART.

#### 1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original unopened packaging and/or containers labeled with the manufacturer's name, brand name, model number, and installation instructions.
- B. Store and protect materials from damage and weather.
  - 1. Verify storage area with Using Agency so as not to interfere with daily or monthly operations.
  - 2. The Government shall accept absolutely no liability for any materials stored on site. It shall be the complete responsibility of the Contractor to provide whatever means necessary to properly secure any and all stored materials.
- C. Any materials damaged either during shipping or storage at the site shall be replaced at Contractor's expense.

#### 1.7 TESTING

- A. The Government retains the right to test any and/or all of the materials required under this Section.
  - 1. Cost for such testing shall be paid for by the Government unless such testing confirms that any such material is not in compliance with the requirements of this Specification in which case the Contractor shall reimburse the Government such cost and shall pay for any retesting costs.
- B. Also see Removal of Non-Compliant Materials, this PART.

#### 1.8 REMOVAL OF NON-COMPLIANT MATERIALS

- A. Any material found not to be in compliance with the requirements of this Section, through testing and/or other means, whether installed individually and/or as a part of a system or not, shall be immediately removed from the job site and replaced with compliant materials at no additional cost to the Contract.

## PART 2 – PRODUCTS

### DISCLAIMER:

Items specified by specific name of a manufacturer are only to establish a standard for operation, quality, characteristics, type, performance, etc. Equal products by other manufacturers will be considered for inclusion into this project provided they are submitted with sufficient supporting data/information which to base a decision for approval. In certain cases, which will be so noted, specified items **must** be used in order to be compatible with existing systems.

#### 2.1 HOLLOW METAL DOOR FRAME

- A. Frames shall be 16 gauge, minimum, cold rolled steel knock-down type and of the size shown on the Drawings/Door and Frame Schedule.
- B. Corners of frame shall be mitered and provided with four locking tabs.
- C. Hinge and strike locations shall be mortised, receive additional 8 gauge steel plate reinforcing welded to frame and factory tapped for finish hardware screws.
- D. Top of frame shall be reinforced, if scheduled to receive a closer.
- E. Frames shall be pre-punched for 3 each silencers on strike side of opening
- F. Frame shall be provided with a sill anchor and a minimum of three anchors per side, which shall be of a type compatible with the construction of the wall rough opening.
- G. Frame shall be phosphatized and receive one coat of factory applied primer.

#### 2.2 EXTERIOR HOLLOW-METAL DOORS (INSULATED)

- A. Doors shall be SDI Grade II, 18 gauge, minimum, full flush type, visible edge seam and of the size and thickness shown on the Drawings/Door and Frame Schedule.
- B. Doors shall be reinforced, stiffened and sound deadened with insulated polyurethane foam core completely filling the inside of the door and laminated to the inside face of the steel panels.
- C. Top and bottom of door shall have 14 gauge steel channels shop welded within door skin.
- D. Top of door shall be provided with additional 14 gauge reinforcing if scheduled to receive a closer.
- E. Top recess of exterior doors shall receive shop welded cap to prevent accumulation of water.
- F. Hinge and strike edges of door shall be beveled  $\frac{1}{8}$ " in 2"; and have vertical mechanical interlocking seams.
- G. Door shall be prepared with cutouts, additional reinforcing, etc., as required to receive finish hardware.

- H. Door shall be phosphatized and receive one coat of factory applied primer.
- I. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value R-9, min.

## 2.3 SILENCERS

- A. Silencers shall be rubber force fit type. Adhesive applied silencers shall not be acceptable.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Rough opening for door assemblies shall be checked for plumb, square and level, prior to start of frame installation, to insure proper installation of door. Contractor shall be responsible for any required correction necessary.

### 3.2 FRAME INSTALLATION

- A. All frames shall be installed in compliance with the Manufacturer's recommendations and be plumb, square, rigid and true in all directions .
  - 1. Center frames in rough openings so that all contact surfaces are of a tight and even fit without forcing or distortion of components, secure to opening sub-frame sides with appropriate anchors and to the floor with sill anchors.
- B. Frame shall be completely caulked around perimeter.
- A. Install silencers of strike side of frame.
- B. Doors shall be adjusted, if required, to allow it to swing freely, and be aligned with frame when latched.

### 3.3 CLEANING/PRIMER TOUCH-UP

- A. Clean surfaces of door and frame of excess sealants and other foreign matter.
- B. Immediately after complete installation of the door and frame, sand smooth any rusted and/or damaged areas of the prime coat and repaint with like primer.

### 3.4 PROTECTION

- A. Contractor shall employ whatever means necessary to protect doors and hardware from damage by subsequent construction operations.

END OF SECTION

SECTION 083323  
OVERHEAD COILING DOORS

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. Insulated service doors.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.
  - 1. Wind Loads: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
    - a. Basic Wind Speed: 90 mph.
    - b. Exposure Category: C

1.4 SUBMITTALS

- A. Make submissions in accordance with Division 1 Specifications and ‘SCHEDULE OF MATERIAL SUBMITTALS’, attached at the end of the Specifications.
- B. No deviations, substitutions, or changes of materials, to be incorporated into this project, shall be made after approval by the Department, except for written direction by and the approval of the manufacturer of a specific item and re-approval by the Department.
- C. The Department retains the right to require additional items not specifically denoted to be submitted for approval and/or additional clarification.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

- B. Single-Source Responsibility: Provide doors, guides, motors, and related primary components from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.
- C. Pre-Installation Conference: Schedule and convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
- 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.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in labeled protective packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage from weather, excessive temperatures, and construction operations.

## PART 2 - PRODUCTS

### 2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  - 1. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
  - 2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
- B. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from metal to match curtain slats and finish.
- C. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- D. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

### 2.2 HOOD

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that project beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

## 2.3 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  - 1. Lock Cylinders: Provide cylinders standard with manufacturer and keyed to building keying system.
  - 2. Keys: Provide Three for each cylinder.
- C. Chain Lock Keeper: Suitable for padlock.
- D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## 2.4 CURTAIN ACCESSORIES

- A. Weather seals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.
  - 1. At door head, use 1/8-inch-thick, replaceable, continuous sheet secure to inside of hood.
  - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.
- B. Bird Repellent Barrier to be provided.
- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door. Provide pull-down straps or pole hooks for doors more than 84 inches high.

## 2.5 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.6 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
  2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Electric Motors:
1. Electrical Characteristics:
    - a. Phase: Three phase.
    - b. Volts: 208V.
    - c. Hertz: 60.
    - d. 1 hp
  2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
  3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec. without exceeding nameplate ratings or service factor.
  4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
- D. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
1. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable. Provide self-monitoring capability designed to interface with door operator control circuit to detect damage to or disconnection of sensing device.
- E. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- F. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- G. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

## 2.7 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to,
  - a. Cookson Company.
  - b. Cornell Iron Works, Inc.
  - c. Overhead Door Corporation.
  - d. Raynor.
  - e. Or "Approved Equal."
- B. Operation Cycles: Not less than 100,000.
- C. Curtain R-Value: Minimum of R-10.9.
- D. Door Curtain Material: Galvanized steel.
- E. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
- F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- G. Hood: Match curtain material and finish.
  1. Shape: Round.
  2. Mounting: Face of wall.
- H. Integral Frame, Hood, and Fascia for Counter Door: Galvanized steel.
  1. Mounting: Face of wall.
- I. Locking Devices: Equip door with locking device assembly.
  1. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from inside with thumb turn.
- J. Electric Door Operator:
  1. Usage Classification: Heavy duty, 60 to 90 cycles per hour.
  2. Motor Exposure: Interior.
  3. Emergency Manual Operation: Chain type.
  4. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar; self-monitoring type.
  5. Remote-Control Station: Interior.
- K. Door Finish:
  1. Baked-Enamel or Powder-Coated Finish: Color as selected by Government Design Professional from manufacturer's full range.



## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Fire-Rated Doors: Install according to NFPA 80.
- C. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.
- D. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer. Adjust seals to provide weathertight fit around entire perimeter.

### 3.2 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 087111  
DOOR HARDWARE

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:
  - 1. Commercial door hardware for the following:
    - a. Swinging doors.
    - b. Other doors to the extent indicated.
  - 2. Cylinders for doors specified in other Sections.
- B. Related Sections include the following:
  - 1. Division 8 Section “Hollow Metal Doors and Frames.”
  - 2. Division 8 Section “Overhead Coiling Doors.”
  - 3. Division 8 Section “Sectional Doors.”

1.3 SUBMITTALS

- A. Make submissions in accordance with Division 1 Specifications and ‘SCHEDULE OF MATERIAL SUBMITTALS’, attached at the end of the Specifications.
- B. No deviations, substitutions or changes of materials, to be incorporated into this project, shall be made after approval by the Department, except for written direction by and the approval of the manufacturer of a specific item and re-approval by the Department.
- C. The Department retains the right to require additional items not specifically denoted to be submitted for approval and/or additional clarification.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- D. Regulatory Requirements: Comply with provisions of the following:
  1. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," as follows:
    - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
    - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
      - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
      - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
    - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
  2. NFPA 101: Comply with the following for means of egress doors:
    - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
    - b. Door Closers: Not more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
    - c. Thresholds: Not more than 1/2 inch high.

#### 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 related to the final Door Hardware Schedule and include basic installation instructions with each item or package.
- C. Deliver keys to Government Representative or Contracting Officer.

#### 1.6 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
  1. Structural failures including excessive deflection, cracking, or breakage.

2. Faulty operation of operators and door hardware.
  3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- C. Warranty Period: Three (3) years from date of Substantial Completion, unless otherwise indicated.
- D. Warranty Period for Manual Closers: Ten (10) years from date of Substantial Completion.

## 1.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door as scheduled on sheet A.5.1 to comply with requirements in this Section.
1. Door Hardware Sets: Requirements for quantity, item, design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Schedule. Products are identified by descriptive titles corresponding to requirements specified in Part 2.
  2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

### 2.2 HINGES AND PIVOTS, GENERAL

- 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. Hinges:
    - a. Stanley Commercial Hardware; Div. of The Stanley Works.
  2. Continuous Geared Hinges:
    - a. McKinney Products Company; Div. of ESSEX Industries, Inc.
- B. Standards: Comply with the following:
1. Butts and Hinges: BHMA A156.1.
  2. Template Hinge Dimensions: BHMA A156.7.
- C. Quantity: Provide the following, unless otherwise indicated:
1. Two Hinges: For doors with heights up to 60 inches.

2. Three Hinges: For doors with heights 61 to 90 inches.
3. Four Hinges: For doors with heights 91 to 120 inches.
4. Four Hinges: For dutch doors, 2 hinges per leaf.
5. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

D. Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

Maximum Door Size (inches)	Hinge Height (inches)	Metal Thickness (inches)	
		Standard Weight	Heavy Weight
32 by 84 by 1-3/8	3-1/2	0.123	-
36 by 84 by 1-3/8	4	0.130	-
36 by 84 by 1-3/4	4-1/2	0.134	0.180
42 by 90 by 1-3/4	4-1/2	0.134	0.180
48 by 120 by 1-3/4	5	0.146	0.190

E. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

F. Hinge Applications: Unless otherwise indicated, provide the following:

1. Entrance Doors: Heavy-weight hinges.
2. Doors with Closers: Antifriction-bearing hinges.
3. Interior Doors: Standard-weight hinges.

G. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless steel, with stainless-steel pin.
2. Interior Hinges: Stainless steel, with stainless-steel pin.
3. Hinges for Fire-Rated Assemblies: Stainless steel, with stainless-steel pin.

H. Hinge Options: Comply with the following:

1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
  - a. Outswinging exterior doors.
  - b. Outswinging corridor doors with locks.
2. Corners: Square.
3. Reverse Safety Stud: Metal stud extension on back of each leaf that engages hole in reinforcing plate.
4. Safety Stud: Metal stud extension on exposed side of one leaf that engages hole in opposite leaf when door is closed.

I. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Screws: Phillips flat-head screws; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

## 2.3 HINGES

- A. Antifriction-Bearing, Full-Mortise (Butt) Hinges: Standard weight; BHMA Grade 2, with 2 ball bearings; button tips; non-rising removable pins; and base metal as follows:
  1. Base Metal: Stainless steel.
- B. Plain-Bearing, Standard-Weight, Full-Mortise (Butt) Hinges: BHMA Grade 3, button tips, non-rising removable pins, and base metal as follows:
  1. Base Metal: Stainless steel.

## 2.4 LOCKS AND LATCHES, GENERAL

- 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. Mechanical Locks and Latches:
    - a. Lock Cores shall be Best Access Systems. Best Access Systems has been approved by DGS as a proprietary item. No other manufacturers/items will be accepted.
- B. Standards: Comply with the following:
  1. Bored Locks and Latches: BHMA A156.2.
  2. Mortise Locks and Latches: BHMA A156.13.
  3. Interconnected Locks and Latches: BHMA A156.12.
  4. Auxiliary Locks: BHMA A156.5.
  5. Push-Button Combination Locks: BHMA A156.2.
- C. Bored Locks: BHMA Grade 2; Series 4000.
- D. Mortise Locks: Stamped steel case with steel or brass parts; BHMA Grade 2; Series 1000.
- E. Interconnected Locks: BHMA Grade 1, unless Grade 2 is indicated; Series 5000.
- F. Auxiliary Locks: BHMA Grade 1, unless Grade 2 is indicated.
- G. Push-Button Combination Locks: BHMA Grade 1 for cylindrical locks, Grade 2 for mortise locks.
- H. Certified Products: Provide door hardware listed in the following BHMA directories:
  1. Mechanical Locks and Latches: BHMA's "Directory of Certified Locks & Latches."
- I. Lock Trim: Comply with the following:

1. Lever: Wrought, forged, or cast.
2. Knob: Wrought, forged, or cast.
3. Escutcheon (Rose): Wrought, forged, or cast.
4. Dummy Trim: Match lever lock trim and escutcheons.
5. Lockset Designs: Provide lockset design designated below or, if sets are provided by another manufacturer, provide designs that match those designated:

a. Bored Locks: Best Access Systems.

J. Lock Functions: Function numbers and descriptions indicated in the Door Hardware Schedule comply with the following:

1. Bored Locks: BHMA A156.2.
2. Mortise Locks: BHMA A156.13.
3. Interconnected Locks: BHMA A156.12.

K. Lock Throw: Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:

1. Bored Locks: Minimum 1/2-inch latch bolt throw.
2. Mortise Locks: Minimum 3/4-inch latch bolt throw.
3. Deadbolts: Minimum 1-inch bolt throw.

L. Rabbeted Doors: Provide special rabbeted front and strike on locksets for rabbeted meeting stiles.

M. Backset: 2-3/4 inches, unless otherwise indicated.

## 2.5 MECHANICAL LOCKS AND LATCHES

A. Bored Auxiliary Locks: Comply with the following:

1. Material: Stainless steel.
2. Deadlocks: Deadbolt operated by key either side.

## 2.6 DOOR BOLTS, GENERAL

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. Flush Bolts: Best Access Systems.

B. Standards: Comply with the following:

1. Automatic and Self-Latching Flush Bolts: BHMA A156.3.
2. Manual Flush Bolts: BHMA A156.16.

C. Flush Bolts: BHMA Grade 2, designed for mortising into door edge.

D. Bolt Throw: Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:

1. Mortise Flush Bolts: Minimum 3/4-inch throw.

## 2.7 DOOR BOLTS

- A. Automatic Flush Bolts: Fabricated from steel and brass components, with spring-activated bolts that automatically retract when active leaf is opened and that automatically engage when active door depresses bolt trigger. Provide brass or stainless-steel cover plate, top and bottom strikes, guides, guide supports, wear plates, and shims.
- B. Self-Latching Flush Bolts: Fabricated from steel and brass components, with spring-activated bolts that automatically engage when active door depresses trigger. Bolts are manually retracted by a slide in the bolt face. Provide brass or stainless-steel cover plate, top and bottom strikes, guides, guide supports, wear plates, and shims.

## 2.8 SURFACE BOLTS

- A. Surface Bolts: BHMA A156.16.
- B. Half-Round Surface Bolts: Grade 2, 6-inch polished-brass or burnished-steel, half-round rod and knob; minimum 7/8-inch throw; with universal strike.

## 2.9 EXIT DEVICES, GENERAL

- 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. Corbin Russwin Architectural Hardware; Div. of Yale Security Inc.
- B. Standard: BHMA A156.3.
  1. BHMA Grade: Grade 1, unless Grade 2 is indicated.
- C. Certified Products: Provide exit devices listed in BHMA's "Directory of Certified Exit Devices."
- D. 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.
- E. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
  1. Operation: Rigid.
- F. Outside Trim: Knob with cylinder; material and finish to match locksets, unless otherwise indicated.
  1. Match design for locksets and latch sets, unless otherwise indicated.
- G. Through Bolts: For exit devices and trim on metal doors.

## 2.10 EXIT DEVICES AND AUXILIARY ITEMS



A. Mortise Exit Devices: Comply with the following:

1. Type: Type 3.
2. Actuating Bar: Push pad.
3. Material: Stainless steel.

## 2.11 CYLINDERS AND KEYING

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. Cylinders: Same manufacturer as for locks and latches.

B. Standards: Comply with the following:

1. Cylinders: BHMA A156.5.

C. Cylinder Grade: BHMA Grade 2.

D. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Seven (7).
2. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
3. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
4. Bored-Lock Type: Cylinders with tailpieces to suit locks.
  - a. High-Security Grade: BHMA Grade 1A, listed and labeled as complying with pick- and drill-resistant testing requirements of UL 437 (Suffix A).

E. Permanent Cores: WA Premium Heavy Key; finish face to match lockset; complying with the following:

1. Best Access Systems: DMVA STANDARD, **NO SUBSTITUTIONS.**
2. Standard Core: WA Premium Heavy Key (PT# ICP7WA1-626)
3. CORES SHALL BE DELIVERED TO THE DEPARTMENT FOR KEYING. UPON COMPLETION, CORE WILL BE RETURNED TO THE CONTRACTOR FOR INSTALLATION.

### **Shipping Address:**

**Dept. of Military and Veterans Affairs Bureau of Facilities and Engineering  
Bldg. 11-64, Ft. Indiantown Gap  
Annville, PA. 17003  
ATTN: Mike Shuttlesworth**

F. Construction Keying: Comply with the following:

1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
2. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 5 construction master keys.
  - a. Turn cores over to Government once all construction is complete.

G. Keying System: Unless otherwise indicated, provide a factory-registered keying system complying with the following requirements:

1. Master Key System: Cylinders are operated by a change key and a master key.
2. Keyed Alike: Key all cylinders to the same change key.
  - a. Cylinders shall be master keyed.

H. Keys: Provide nickel-silver keys complying with the following:

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
  - a. Notation: Information to be furnished by Owner.
2. Quantity: In addition to one extra blank key for each lock, provide the following:
  - a. Cylinder Change Keys: Three.
  - b. Master Keys: Five.

I. Permanent Keying: Unless otherwise indicated, Government will be responsible for all permanent keying.

## 2.12 STRIKES

A. Standards: Comply with the following:

1. Strikes for Bored Locks and Latches: BHMA A156.2.
2. Strikes for Mortise Locks and Latches: BHMA A156.13.
3. Strikes for Interconnected Locks and Latches: BHMA A156.12.
4. Strikes for Auxiliary Deadlocks: BHMA A156.5.

B. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latch bolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

## 2.13 OPERATING TRIM, GENERAL

- 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. Stanley Commercial Hardware; Div. of The Stanley Works.
- B. Standard: Comply with BHMA A156.6.
- C. Materials: Fabricate from stainless steel, unless otherwise indicated.

#### 2.14 OPERATING TRIM

- A. Flat Push Plates: 0.050 inch thick, 4 inches wide by 16 inches high; with square corners and beveled edges, secured with exposed screws.
- B. Single Push Bar: Horizontal bar, with minimum clearance of 1-1/2 inches from face of door, and as follows:
  - 1. Shape and Size: Minimum 3/8-by-1-1/4-inch flat bar.
  - 2. Mounting: Surface applied with concealed fasteners.

#### 2.15 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.
- B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Flat Overlapping Astragals: BHMA A156.22; flat stainless steel metal bar, surface mounted on face of door with screws; minimum 1/8 inch thick by 2 inches wide by full height of door.

#### 2.16 CLOSERS, GENERAL

- 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. Surface-Mounted Closers:
- B. Standards: Comply with the following:
  - 1. Closers: BHMA A156.4.
- C. Surface Closers: BHMA Grade 2.
- D. Certified Products: Provide door closers listed in BHMA's "Directory of Certified Door Closers."

- E. Power-Assist Closers: As specified in Division 8 Section "Power Door Operators" for access doors for the disabled or where listed in the Door Hardware Schedule. Provide electrohydraulic, electromechanical, and pneumatic types as indicated.
- F. Size of Units: Unless otherwise indicated, 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.

## 2.17 CLOSERS

- A. Modern-Type-with-Cover Surface Closers: Rack-and-pinion hydraulic type; with adjustable sweep and latch speeds controlled by key-operated valves; with forged-steel main arm; enclosed in cover indicated; complying with the following:
  - 1. Mounting: Hinge side.
  - 2. Type: Delayed action closing.
  - 3. Backcheck: Adjustable, effective between 60 and 85 degrees of door opening.
  - 4. Cover Material: Aluminum.
  - 5. Closing Power Adjustment: At least 35 percent more than minimum tested value.

## 2.18 PROTECTIVE TRIM UNITS, GENERAL

- 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. Metal Protective Trim Units:
    - a. Baldwin Hardware Corporation.
- B. Standard: Comply with BHMA A156.6.
- C. Materials: Fabricate protection plates from the following:
  - 1. Stainless Steel: 0.050 inch thick; beveled top and 2 sides.
- D. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine or self-tapping screws.
- E. Furnish protection plates sized 1-1/2 inches less than door width on push side and 1/2 inch less than door width on pull side, by height specified in schedule.

## 2.19 PROTECTIVE TRIM UNITS

- A. Kick Plates: 12 inches high by door width, with allowance for frame stops.

## 2.20 STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1 unless Grade 2 is indicated.

1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
- B. Dome-Type Floor Stop: Grade 1; with minimum 1-inch high bumper for door without threshold and 1-3/8-inch- high bumper for doors with threshold.
- C. Chain Doorstops (Exterior Doors): Heavy-duty compressions spring on both ends of chain and end brackets, thick gauge steel brackets, welded solid steel chains, weather and rip resistant vinyl cover.
  1. Comply with BHMA A156.16, Grade 1.
  2. Spring Diameter: 13/16"

## 2.21 DOOR GASKETING, GENERAL

- 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. Door Gasketing:
    - a. Reese Enterprises, Inc.
- B. Standard: Comply with BHMA A156.22.
- C. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide non-corrosive fasteners for exterior applications and elsewhere as indicated.
  1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- D. Air Leakage: Not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Gasketing Materials: Comply with ASTM D 2000 and AAMA 701/702.

## 2.22 DOOR GASKETING

- A. Adhesive-Backed Perimeter Gasketing: Gasket material applied to frame rabbet with self-adhesive.
  1. Gasket Material: Sponge neoprene.
- B. Door Shoe Sweep: Vinyl gasket material held in place by aluminum housing; mounted to bottom edge of door with screws.
  1. U-shaped Door Shoe.
  2. Vinyl 3-Fingered Seal.

## 2.23 THRESHOLDS, GENERAL

- 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. Reese Enterprises, Inc.
- B. Standard: Comply with BHMA A156.21.

## 2.24 THRESHOLDS

- A. Plate Thresholds: Solid metal plate; and base metal as follows:
  - 1. Top Surface: Fluted with slip-resistant abrasive.
  - 2. Base Metal: Stainless steel.
  - 3. ADA approved.

## 2.25 MISCELLANEOUS DOOR HARDWARE, GENERAL

- 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:
- B. Standard: Comply with the following:
  - 1. Auxiliary Hardware: BHMA A156.16.
  - 2. Auxiliary Hardware: BHMA Grade 2, unless otherwise indicated.

## 2.26 FABRICATION

- A. Manufacturer's Nameplate: Do not provide manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise approved by Architect.
  - 1. Manufacturer's identification will be permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal, 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 for finishes. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. 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. Steel Machine or Wood Screws: For the following fire-rated applications:
  - a. Mortise hinges to doors.
  - b. Strike plates to frames.
  - c. Closers to doors and frames.
3. Steel Through Bolts: For the following fire-rated applications, unless door blocking is provided:
  - a. Closers to doors and frames.
4. Spacers or Sex Bolts: For through bolting of hollow metal doors.

## 2.27 FINISHES

- A. Standard: Comply with BHMA A156.18.
- 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.
- D. BHMA Designations: Comply with base material and finish requirements indicated by the following:
  1. BHMA 600: Primed for painting, over steel base metal.
  2. BHMA 605: Bright brass, clear coated, over brass base metal.
  3. BHMA 606: Satin brass, clear coated, over brass base metal.
  4. BHMA 609: Satin brass, blackened, satin relieved, clear coated, over brass base metal.
  5. BHMA 611: Bright bronze, clear coated, over bronze base metal.
  6. BHMA 612: Satin bronze, clear coated, over bronze base metal.
  7. BHMA 613: Dark-oxidized satin bronze, oil rubbed, over bronze base metal.
  8. BHMA 618: Bright nickel plated, clear coated, over brass or bronze base metal.
  9. BHMA 619: Satin nickel plated, clear coated, over brass or bronze base metal.
  10. BHMA 622: Flat black coated, over brass or bronze base metal.
  11. BHMA 623: Light-oxidized statuary bronze, clear coated, over bronze base metal.
  12. BHMA 624: Dark-oxidized statuary bronze, clear coated, over bronze base metal.
  13. BHMA 625: Bright chromium plated over nickel, over brass or bronze base metal.
  14. BHMA 626: Satin chromium plated over nickel, over brass or bronze base metal.
  15. BHMA 627: Satin aluminum, clear coated, over aluminum base metal.
  16. BHMA 628: Satin aluminum, clear anodized, over aluminum base metal.
  17. BHMA 629: Bright stainless steel, over stainless-steel base metal.
  18. BHMA 630: Satin stainless steel, over stainless-steel base metal.
  19. BHMA 651: Bright chromium plated over nickel, over steel base metal.
  20. BHMA 652: Satin chromium plated over nickel, over steel base metal.
  21. BHMA 689: Aluminum painted, over any base metal.
  22. BHMA 690: Dark bronze painted, over any base metal.
  23. BHMA 691: Light bronze painted, over any base metal.

24. BHMA 717: Bright aluminum, uncoated; aluminum base metal.
25. BHMA 718: Satin aluminum, uncoated; aluminum base metal.
26. BHMA 722: Dark-oxidized bronze, oil rubbed, over architectural bronze base metal.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance of door hardware.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
- 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 specified in Division 9 Sections. 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. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

#### 3.3 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner 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.

#### 3.4 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. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- B. Six-Month Adjustment: Approximately six months after date of Substantial Completion, Installer shall perform the following:
  1. Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.
  2. Consult with and instruct Owner's personnel on recommended maintenance procedures.
  3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

### 3.5 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 door hardware is without damage or deterioration at time of Substantial Completion.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

END OF SECTION

SECTION 092900

GYPSUM BOARD

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:
  - 1. Interior gypsum board.

1.3 SUBMITTALS

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

1.4 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

- A. The following conditions MUST BE met prior to the installation of gypsum board.
- B. 1. Hanging Gypsum Board: Building envelope shall be permanently sealed so that to prevent the infiltration of outside elements (wind, rain, etc.) and a minimum temperature of 40° F shall be established and maintained throughout installation.
- C. 2. Finishing Gypsum Board: Areas to be finished shall maintain a minimum temperature of 50° F for at least 24 hours prior to the start of the finishing process and be held during and after completion of work.
- D. 3. Contractor shall contact the On-Site Government Inspector at least 48 hours prior to the start of any gypsum board work. Work will not be permitted until space conditions, as detailed above, are verified by the Government Inspector.
- E. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- F. 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 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### 2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
  1. 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:
    - a. American Gypsum Co.
    - b. G-P Gypsum.
    - c. USG Corporation.
- B. Gypsum Board: ASTM C 1396/C 1396M.
  1. Thickness: 5/8 inch
  2. Long Edges: Tapered.
- C. Moisture and Mold Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
  1. Core: 5/8 inch, Type X.
  2. Long Edges: Tapered.
  3. Mold Resistance: ASTM D 3273, score of 10.

### 2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
  2. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. Expansion (control) joint.

### 2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  - 1. Interior Gypsum Wallboard: Paper.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  - 3. Fill Coat: For second coat, use setting-type, sand-able topping compound.
  - 4. Finish Coat: For third coat, use setting-type, sand-able topping compound.

## 2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. 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 thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, 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 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. 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-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. 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.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Regular Type: As indicated on Drawing A.3.2.
  - 2. Moisture- and Mold-Resistant Type: As indicated on Drawing A.3.2.
- 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 horizontally (perpendicular 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. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

### 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. Bullnose Bead: Use at outside corners.

### 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. Pre-fill open joints rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  1. Level 3: Throughout.
    - a. Primer and its application to surfaces are specified in other Division 9 Sections.

### 3.6 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, 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

SECTION 095123  
ACOUSTICAL TILE CEILINGS

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 acoustical tiles for ceilings and the following:
  - 1. Concealed suspension systems.
  - 2. Acoustical Ceiling Tiles
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light-Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Make submissions in accordance with Division 1 Specifications and ‘SCHEDULE OF MATERIAL SUBMITTALS’, attached at the end of the Specifications.
- B. No deviations, substitutions or changes of materials, to be incorporated into this project, shall be made after approval by the Department, except for written direction by and the approval of the manufacturer of a specific item and re-approval by the Department.
- C. The Department retains the right to require additional items not specifically denoted to be submitted for approval and/or additional clarification.

1.5 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated.

NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

- B. Source Limitations:
  - 1. Acoustical Ceiling Tile: Obtain each type through one source from a single manufacturer.
  - 2. Suspension System: Obtain each type through one source from a single manufacturer.
- C. Source Limitations: Obtain each type of acoustical ceiling tile and supporting suspension system through one source from a single manufacturer.
- D. Fire-Test-Response Characteristics: Provide acoustical tile ceilings that comply with the following requirements:
  - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical tile ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
    - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
    - b. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - 2. Surface-Burning Characteristics: Provide acoustical tiles with the following surface-burning characteristics complying with ASTM E 1264 for Class B materials as determined by testing identical products per ASTM E 84:
    - a. Smoke-Developed Index: 450 or less.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical tiles, 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 tiles, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical tile 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 tile ceiling installation.



## 1.8 COORDINATION

- A. Coordinate layout and installation of acoustical tiles and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Units: Full-size tiles equal to 2.0 percent of quantity installed.
  - 2. Suspension System Components: Quantity of each concealed grid and exposed component equal to 2.0 percent of quantity installed.

## PART 2 - PRODUCTS

### 2.1 ACOUSTICAL TILES, GENERAL

- A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance's, 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 away from test surface per ASTM E 795.
- B. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of acoustical tiles are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

### 2.2 ACOUSTICAL TILES FOR ACOUSTICAL TILE CEILING

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong World Industries, Inc.; Cortega Lay-in Tile
  - 2. USG Interiors, Inc.
  - 3. "Or Approved Equal"
- B. Classification: Provide fire-resistance-rated tiles complying with ASTM E 1264 for type, form, and pattern as follows:
  - 1. Type III, mineral base with painted finish; Form 4, Mineral Fiber, Wet Formed.
  - 2. Pattern: CE (perforated, small holes with light to medium texture).

- C. Color: White.
- D. Size: 24" x 24"
- E. LR: Not less than 0.80.
- F. NRC: Not less than 0.55.
- G. CAC: Not less than 30.
- H. AC: Not less than 170.
- I. Edge/Joint Detail: Based upon selected manufacturer's standard.
- J. Thickness: 5/8 inch.

### 2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. 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 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

### 2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL TILE CEILING

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong World Industries, Inc.; Prelude ML 15/16" Exposed Grid System.
  - 2. USG Interiors, Inc.
  - 3. "Or Approved Equal"

- B. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, pre-painted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, G30 coating designation.
  - 1. Structural Classification: Intermediate-duty system.
  - 2. Access: Upward and end or side pivoted, with initial access openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.

## 2.5 METAL EDGE MOLDINGS AND TRIM

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong World Industries, Inc.; Prelude ML 15/16” Exposed Grid System.
  - 2. USG Interiors, Inc.
  - 3. “Or Approved Equal”
- B. Hot-dipped Galvanized Steel, 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 tile 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.
  - 3. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; organic coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile 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 tile ceilings.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders and comply with layout shown on reflected ceiling plans.

### 3.3 INSTALLATION, SUSPENDED ACOUSTICAL TILE CEILINGS

- A. General: Install acoustical tile ceilings to comply with UBC Standard 25-2 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
  - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- 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, counter splaying, or other equally effective means.
  - 3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
  - 4. 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.
  - 5. 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.
  - 6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  - 7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  - 8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - 9. Do not attach hangers to steel deck tabs.
  - 10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  - 11. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  - 12. 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 tile ceiling area and where necessary to conceal edges of acoustical tiles.
  - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  - 2. Screw attaches moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of
  - 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. Arrange directionally patterned acoustical tiles as follows:
  - 1. Install tiles with pattern running in one direction parallel to short axis of space.
- G. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.
  - 1. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile.
  - 2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tile and moldings, spaced 12 inches o.c.
  - 3. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

#### 3.4 CLEANING

- A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096513  
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

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.

1.4 QUALITY ASSURANCE

- 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 or more than 90 deg F.

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products 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 or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

## PART 2 - PRODUCTS

### 2.1 RESILIENT BASE

- A. Resilient Base:
  - 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. Armstrong World Industries, Inc.
    - b. Johnsonite.
    - c. Roppe Corporation, USA.
    - d. "Or Approved Equal"
- B. Resilient Base Standard: ASTM F 1861.
  - 1. Material Requirement: Type TV (vinyl, thermoplastic).
  - 2. Manufacturing Method: Group I (solid, homogeneous).
  - 3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.080 inch.
- D. Height: 4 inches.
- E. Lengths: 48 inches long or coils in manufacturer's standard length.
- F. Outside Corners: Job formed or preformed.
- G. Inside Corners: Job formed or preformed.
- H. Finish: As selected by Government Design Professional from manufacturer's full range.
- I. Colors and Patterns: As selected by Government Design Professional from full range of industry colors.

## 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 resilient products and substrate conditions indicated.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Cove Base Adhesives: Not more than 50 g/L.
    - b. 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 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.
- B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
  - 4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. Fill cracks, holes, and depressions in substrates with trowel able leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the 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.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 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. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
  2. 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.
- B. Perform the following operations immediately after completing resilient product 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 resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 097200  
WALL COVERINGS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division – 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. FRP (Fiber-glass Reinforced Panels)

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.
- B. Samples for Initial Selection: Manufacturer’s standard brochure for color and texture selection.
- C. Maintenance Data: For wall coverings to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide wall coverings and adhesives with the following fire-test-response characteristics as determined by testing identical products applied with identical adhesives to substrates per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Surface-Burning Characteristics: As follows, per ASTM E 84:
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install wall coverings 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.
- B. Lighting: Do not install wall covering until a lighting level of not less than 15 fc is provided on the surfaces to receive wall covering.

- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

## 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Provide two (2) extra panels per each room covering is being installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in Part 2 "Wall-Covering Products" Article.
  - a. Sequentia: StructoGlas FRP
  - b. "Or Approved Equal"

### 2.2 WALL-COVERING PRODUCTS

- A. General: Provide rolls of each type of wall covering from the same run number or dye lot.
- B. FRP (Fiber-glass Reinforced Panels):
  - 1. Size: 48 inches by 96 inches by .090 inches
  - 2. Colors, Textures, and Patterns: As selected by Government Design Professional from manufacturer's full range.

### 2.3 ACCESSORIES

- A. Adhesive: Mildew-resistant, non-staining, strippable adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall-covering manufacturer.
- B. Seam Tape: As recommended in writing by wall-covering manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair wall covering's bond, including mold, mildew, oil, grease, incompatible primers, dirt, and dust.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
  - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete and concrete masonry units when tested with an electronic moisture meter.
  - 2. Gypsum Board: Prime with primer recommended by wall-covering manufacturer.
- D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

### 3.3 INSTALLATION

- A. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Install seams vertical and plumb at least 6 inches from outside corners and 3 inches from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
- C. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

### 3.4 CLEANING

- A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

SECTION 099123  
INTERIOR PAINTING

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 surface preparation and the application of paint systems on the following interior substrates:
  - 1. Gypsum board.
  - 2. Metal Doors/Frames, Lintels.
  - 3. Exposed Wood

1.3 SUBMITTALS

- A. Make submissions in accordance with Division 1 Specifications and 'SCHEDULE OF MATERIAL SUBMITTALS', attached at the end of the Specifications.
- B. No deviations, substitutions, or changes of materials, to be incorporated into this project, shall be made after approval by the Department, except for written direction by and the approval of the manufacturer of a specific item and re-approval by the Department.
- C. The Department retains the right to require additional items not specifically denoted to be submitted for approval and/or additional clarification.

1.4 QUALITY ASSURANCE

- A. MPI Standards:
  - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
  - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

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.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

## 1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

## 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

## 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. M.A.B. Paints.
  - 2. Sherwin-Williams Company (The).
  - 3. Or "Approved Equal."

### 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. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:
  - 1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
  - 2. Non-flat Paints and Coatings: VOC content of not more than 150 g/L.
  - 3. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
  - 4. Restricted Components: Paints and coatings shall not contain any of the following:

- a. Acrolein.
- b. Acrylonitrile.
- c. Antimony.
- d. Benzene.
- e. Butyl benzyl phthalate.
- f. Cadmium.
- g. Di (2-ethylhexyl) phthalate.
- h. Di-n-butyl phthalate.
- i. Di-n-octyl phthalate.
- j. 1,2-dichlorobenzene.
- k. Diethyl phthalate.
- l. Dimethyl phthalate.
- m. Ethylbenzene.
- n. Formaldehyde.
- o. Hexavalent chromium.
- p. Isophorone.
- q. Lead.
- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

C. Colors: As selected by Government Design Professional from manufacturer's full range.

### 2.3 PRIMERS/SEALERS (1 Coat)

A. Interior Latex Primer/Sealer: MPI #50.

- 1. VOC Content: 200 per liter maximum

### 2.4 METAL PRIMERS (1 Coat)

A. Rust-Inhibitive Primer (Water Based): MPI #107.

- 1. VOC Content: 200 per liter maximum

### 2.5 LATEX PAINTS (2 Coats)

A. Interior Latex (Flat): MPI #53 (Gloss Level 1):

- 1. VOC Content: 100 per liter

B. Interior Latex (Eggshell): MPI #52 (Gloss Level 3):

- 1. VOC Content: 100 per liter

C. Interior Latex (Semigloss): MPI #54 (Gloss Level 5):



1. VOC Content: 100 per liter

### 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 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.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that 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.
  2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. 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.
- E. Aluminum Substrates: Remove surface oxidation.

F. 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.

G. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

### 3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

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.

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.

### 3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

### 3.5 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, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.6 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board Substrates (Wall/Ceiling):
  - 1. Latex System: MPI INT 9.2A.
    - a. Prime Coat: Interior latex primer/sealer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (eggshell).
- B. Exposed Wood
  - a. Prime Coat: Interior latex primer/sealer.
  - b. Intermediate Coat: Interior latex matching topcoat.
  - c. Topcoat: Interior latex (semi-gloss).
- C. Doors & Frames/Lintels:
  - 1. Latex Over Factory Primer System: MPI INT 5.1Q.
    - a. Intermediate Coat: Interior/Exterior latex matching topcoat.
    - b. Topcoat: Interior/Exterior latex (semigloss).

END OF SECTION

SECTION 099600  
EPOXY FLOOR COATINGS

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:
  - 1. Interior Substrates:
    - a. Concrete Floor Slabs

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of finish-coat product indicated.
- C. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 QUALITY ASSURANCE

- A. Qualifications:
  - 1. The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of methyl methacrylate (MMA) industrial flooring and related materials.
  - 2. The Applicator shall have been approved by the flooring system manufacturer in all phases of surface preparation and application of the product specified.

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.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

## 1.6 PROJECT CONDITIONS

- A. Application may proceed when space conditions, material and substrate temperatures are between 35 F and 90 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.
- D. The Applicator shall ensure that adequate ventilation is available for the work area. This shall include the use of manufacturer's approved fans, smooth bore tubing and closure of the work area.
- E. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.
- F. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

## PRODUCTS

### 1.7 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. Dur-A-Flex, Inc.
  - 2. Epoxy Systems, Inc.
  - 3. Sherwin-Williams Company; General Polymers.
  - 4. Or Approved Equal

### 1.8 MATERIALS

- A. VOC Content of Resinous Flooring: Provide resinous flooring systems, for use inside the weatherproofing system, that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - 1. Epoxy Flooring: 100 g/L.

### 1.9 EPOXY FLOORING

- A. Epoxy Flooring: Waterproof, designed to produce a seamless floor.
- B. System Characteristics:
  - 1. Color and Pattern: As selected by Government Design Professional from manufacturer's full range
  - 2. Wearing Surface: Smooth

C. Coats:

1. Primer: As required and recommended by the manufacturer for specific application area and substrate.
2. Base Coat: Minimum of one (1) coat, but as required for specific application area based on manufacturer's recommendation.
3. Topcoat (Sealing or finish coats): Minimum of one (1) coat, but as required by manufacturer.

## EXECUTION

### 1.10 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
    - a. Concrete: 12 percent.
  2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  4. Coating application indicates acceptance of surfaces and conditions.

### 1.11 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
- C. Concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, lantance, friable matter, dirt, and incompatible paints.
1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
- D. The substrate shall be sound and all spalls repaired prior to placement of the prime coat. Spalls and cracks shall be repaired with compatible rapid cure concrete patch materials per Manufacturer's recommendations.
- E. There shall be no visible moisture present on the surface at the time of application of the system. Compressed oil-free air and/or a light passing of a propane torch may be used to dry the substrate.
- F. Bond Test:

1. Random tests for adequate bond strength shall be conducted on the substrate while the surface preparation is ongoing and prior to application of the primer, in accordance with the Manufacturer's recommendations, at minimum frequency of three tests per 5,000 sf. Smaller areas shall receive a minimum of three tests.
2. Based on the test results, additional substrate preparation may be required before proceeding with the installation of the system.

#### 1.12 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions.
  1. Use applicators and techniques suited for coating and substrate indicated.
- B. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
- C. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
- D. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Government Design Professional.
- E. Male and Female Shower Areas: System shall provide proper slope to all new and existing floor drains as depicted on the project design drawings.
- F. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

#### 1.13 FIELD QUALITY CONTROL

- A. Government reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:
  1. Government may direct the Contractor, at no additional cost to engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
  2. Testing agency will perform tests for compliance with specified requirements.
  3. Government may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove non-complying 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.
- B. Tests, Inspection
  1. The following tests shall be conducted by the Applicator:
    - a. Temperature
      1. Air, substrate temperatures and, if applicable, dew point.
    - b. Bond Tests

1. Bond Test of the primer to the substrate shall be checked as per Clause 3.2 C.

c. Coverage Rates

1. Rates for all layers shall be monitored by checking quantity of material used against the area covered.

1.14 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from 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 by cleaning, repairing, replacing, and recoating, as approved by Government Design 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.

END OF SECTION 099600



SECTION 099726  
CEMENTITIOUS COATINGS

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 surface preparation and application of cementitious coating systems on the following substrates:
  - 1. Interior concrete floors (for repair or leveling purposes).

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
  - 1. Product Data for Credit IEQ 4.2: For interior paints and coatings, documentation including printed statement of VOC content.
- C. Samples for Initial Selection: For each finish coat indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each cementitious coating, from manufacturer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency or by a qualified testing agency, for each product formulation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are from same production run (batch mix) as materials applied and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 5 percent of each color applied.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain cementitious coating materials from single source from single manufacturer.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, new, unopened packages and containers bearing manufacturer's name and label, and the following information:
  - 1. Product name or title of material.
  - 2. Manufacturer's stock number and date of manufacture.
  - 3. Contents by volume, for pigment and vehicle constituents.
  - 4. Application instructions.
  - 5. Color name and number.
  - 6. Handling instructions and precautions.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage of coatings in a clean condition, free of foreign materials and residue.
  - 1. Protect cementitious coating materials from freezing. Keep materials dry and storage area neat and orderly. Remove waste daily. Take necessary measures to ensure that workers and work areas are protected from health hazards resulting from handling, mixing, and applying the coating.

## 1.8 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

### 2.1 CEMENTITIOUS COATINGS

- A. Polymer-Modified Cementitious Coating: Containing portland cement, polymer, and hydrated lime or 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. Bonsal American, an Oldcastle company; ProSpec Blender and Resurfacer.
    - b. Or Approved Equal
- B. Performance Requirements: Comply with the following:
  - 1. Compressive Strength: Not less than 3500 psi at 28 days according to ASTM C 109/C 109M.
  - 2. Tensile Strength: Not less than 350 psi at 28 days according to ASTM C 109/C 109M.
  - 3. Flexural Strength: Not less than 1000 psi at 28 days according to ASTM C 348.

- C. Other Materials: Provide crack fillers, block fillers, and related materials that are compatible with cementitious finish-coat materials and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.
- E. Colors: As selected by Government Design Professional from manufacturer's full range.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions for mixing and preparing materials and as applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
  - 1. After completing coating 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 dirt, oil, grease, incompatible coatings, and loose substrate materials.
- D. Cementitious and Masonry Surfaces: 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. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.
  - 1. Cracks Larger Than 1/32 Inch: Cut out static cracks, voids, or honeycombing larger than 1/32 inch and patch with materials recommended in writing by coating manufacturer. Identify dynamic cracks and treat according to manufacturer's written instructions before beginning application.

### 3.3 APPLICATION

- A. Apply coatings according to manufacturer's written instructions. Use applicators and techniques suited for coating and substrate indicated.
  - 1. Dampen substrate of surfaces to receive cementitious coatings one hour before beginning application to prevent surface drag. Immediately before applying coatings, redampen substrate. Substrates shall be saturated surface dry at time of application.
- B. Apply each material at not less than manufacturer's recommended spreading rate. Provide total cured material thickness indicated or as recommended in writing by manufacturer.

### 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 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 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 coated surfaces.

### 3.5 COATING SCHEDULE

- A. General: Apply additional coats when undercoats or other conditions show through final coat until cured film is of uniform coating finish, color, and appearance.
- B. Above-Grade Concrete and Masonry: Two finish coats with total cured thickness not less than 40 mils.
  - 1. First Coat: Apply polymer-modified cementitious coating material at the rate of 2 lb/sq. yd. to achieve a total cured thickness of 25 mils.
  - 2. Second Coat: Apply polymer-modified cementitious coating material at the rate of 1 lb/sq. yd. to achieve a total cured thickness of 15 mils.

END OF SECTION 099726

## SECTION 101400

### SIGNAGE

#### 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:
  - 1. Interior Signage.

##### 1.3 DEFINITIONS

- A. Accessibility Guidelines: "Americans with Disabilities Act (ADA) - Accessibility Guidelines for Buildings and Facilities and Architectural Barriers Act (ABA) - Accessibility Guidelines."

##### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for signs.
  - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  - 2. Provide message list, typestyles, and graphic elements, including tactile characters and Braille, and layout for each sign.
- C. Sign Schedule: Use same designations indicated on Drawings.
- D. Warranty: Special warranty specified in this Section.

##### 1.5 QUALITY ASSURANCE

- A. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- B. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

## 1.6 PROJECT CONDITIONS

- A. Field Limitations: Signage shall be installed only after all required field painting has been completed and field conditions meet that of the manufacturer's written installation recommendations.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration and/or fading of colors.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SIGNAGE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:
  - 1. Best Manufacturing Sign Systems
  - 2. Seton Identification Products.
  - 3. Or "Approved Equal"
- B. Plaques: (Refer to Sheet A.3.1, Typical Sign Detail for Sign Size and Layout Requirements)
  - 1. Material: Melamine Plastic Laminate, approx. 1/8" thick, one-piece construction. Impervious to most acids, alkalis, alcohol, solvents, abrasives and boiling water.
  - 2. Background: Painted and rated non-static, fire-retardant and self-extinguishing.
  - 3. Finish: Background, letters, numbers and characters to be Matte finish.
  - 4. Color: As selected by Government Design Professional from manufacturer's full range of available colors.
  - 5. Border Style: 3/8" wide, 1/32" raised perimeter with 1/8" inside radius.
  - 6. Letters & Numbers: 5/8" High and raised 1/32" from plate face. Upper Case centered on sign and contrasting with background color.
  - 7. Characters/Symbols: 3" high raised 1/32" from plate face and contrasting with background color.
  - 8. Braille: Grade 2, placed directly below last line of letters or numbers, except for room number signs, where Braille shall be placed directly behind the last number.
- C. Rooms to Receive Signage:

<u>Room #</u>	<u>Label</u>	<u>Type</u>
101	Office	2
102	Office	2
103	Electric/IT	1
104	Office	2

105	Storage	1
106	Classroom	2
107	Female Latrine	1
108	Male Latrine	1
109	Janitor Closet	1
110	Electric Room	1

### 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 work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
  - 1. Install all signs level, plumb, and at heights indicated, with sign surfaces free of distortion
  - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
  - 3. Door Signs: Install signs centered on door and at heights per all applicable codes and as detailed on design documents.
- B. Mounting: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
  - 1. Mechanical Fasteners: Use mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

END OF SECTION

SECTION 102113  
TOILET COMPARTMENTS

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. Solid-polymer toilet compartments configured as toilet enclosures and urinal screens.

B. Related Sections:

1. Division 06 Section “Miscellaneous Rough Carpentry” for blocking overhead support of floor-and-ceiling-anchored compartments.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.
2. Show locations of reinforcements for compartment-mounted grab bars.
3. Show locations of centerlines of toilet fixtures.

- C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

- D. Product Certificates: For each type of toilet compartment, from manufacturer.

- E. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.



1. Flame-Spread Index: 75 or less.
  2. Smoke-Developed Index: 450 or less.
- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

## 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221.
- C. Brass Castings: ASTM B 584.
- D. Brass Extrusions: ASTM B 455.
- E. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.
1. Electrolytically Zinc Coated: ASTM A 879/A 879M, 01Z.
  2. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvanized.
- F. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- G. Stainless-Steel Castings: ASTM A 743/A 743M.
- H. Zamac: ASTM B 86, commercial zinc-alloy die castings.
- I. Particleboard: ANSI A208.1, Grade M-2 with 45-lb density, made with binder containing no urea formaldehyde.
- J. Plastic Laminate: NEMA LD 3, general-purpose HGS grade, 0.048-inch nominal thickness.

### 2.2 SOLID-POLYMER UNITS (Drawings A.1.1 and A.3.1)

- 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. Accurate Partitions Corporation.
  2. Bradley Corporation; Mills Partitions.
  3. Partition Systems Incorporated of South Carolina.

4. "Or Approved Equal"
- B. Toilet-Enclosure Style: Floor anchored or Floor and ceiling anchored.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
  1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
  2. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
  3. Color and Pattern: in each room as selected by Government Design Professional from manufacturer's full range.
- E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
- F. Brackets (Fittings):
  1. Stirrup Type: Ear or U-brackets, stainless steel.
  2. Full-Height (Continuous) Type: Manufacturer's standard design.

## 2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
  1. Material: Stainless steel.
  2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
  3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
  4. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

## 2.4 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

- B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- C. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
- D. Door Size and Swings: Unless otherwise indicated, provide 24-inch wide, in-swinging doors for standard toilet compartments and 36-inch wide, out-swinging doors with a minimum 32-inch wide, clear opening for compartments designated as accessible.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install unit's rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.
  - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
    - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- D. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.
- E. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

## 3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

SECTION 102800  
TOILET ROOM ACCESSORIES

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:
1. Washroom accessories.
  2. Underlavatory guards.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
1. Construction details and dimensions.
  2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  3. Material and finish descriptions.
  4. Features that will be included for Project.
  5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
1. Identify locations using room designations indicated on associated floor plans..
  2. Identify products using designations indicated within the large scale toilet room details..
- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Government Design Professional.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

## 1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 15 years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19 flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

### 2.2 WASHROOM ACCESSORIES

- 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. Kimberly-Clark Professional (Government Preferred)
  - 2. "Or Approved Equal"
- B. Toilet Tissue (Roll) Dispenser (KC Model: 09612)
  - 1. Description: Single-Jumbo roll dispenser.
  - 2. Mounting: Surface mounted.

3. Operation: Noncontrol delivery with standard spindle.
4. Capacity: Designed to dispense 9." dia tissue rolls
5. Material and Finish: ABS Plastic in Smoke Grey.

C. Paper Towel (Roll) Dispenser (KC Model: 09736)

1. Description: Lever-actuated mechanism permits controlled delivery of paper rolls in preset lengths per stroke.
2. Mounting: Surface mounted.
3. Capacity: 8-inch wide with 1.5" core
4. Material and Finish: ABS plastic, Smoke Grey.
5. Lockset: Key Activated

D. Liquid-Soap Dispenser (KC Model: 91180)

1. Description: Designed for dispensing soap in liquid or lotion form.
2. Mounting: Vertically oriented, surface mounted.
3. Capacity: 500 or 1000ml (1 pack).
4. Lockset: Keyless lock.
5. Refill Indicator: Window type.

E. Mirror Unit (American Specialties Model: 0600)

1. Frame: Stainless-steel angle, 0.05 inch thick.
  - a. Corners: Manufacturer's standard.
2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
  - a. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
  - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

## 2.3 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of **three** keys to Owner's representative.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION



SECTION 123623.13  
LAMINATE COUNTERTOPS

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 plastic-laminate countertops.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including panel products and adhesive for bonding plastic laminate.
  - 1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. LEED Submittals:
  - 1. Product Data for Credit IEQ 4.1: For installation adhesives, including printed statement of VOC content.
- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show locations and sizes of cutouts and holes for plumbing fixtures installed in plastic-laminate countertops.
- D. Samples for Initial Selection:
  - 1. Plastic laminates.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver countertops until painting and similar operations that could damage countertops have been completed in installation areas. If countertops must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

## 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 40 and 60 percent during the remainder of the construction period.
- B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## PART 2 - PRODUCTS

### 2.1 LAMINATE COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.
- B. Grade: Premium.
  - 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. Formica Corporation;
    - b. Wilsonart International, Div. of Premark International, Inc.;
    - c. Or Approved Equal
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. As selected by Government Design Professional from manufacturer's full range in the following categories:
    - a. Solid colors, matte finish.
    - b. Solid colors with core same color as surface, gloss finish.
    - c. Wood grains, matte finish.
    - d. Patterns, gloss finish.
  - 2. Grain Direction: Parallel to cabinet fronts.
- D. Edge Treatment: Same as laminate cladding on horizontal surfaces.

- E. Core Material: Medium-density fiberboard
- F. Core Material at Sinks: medium-density fiberboard made with exterior glue or exterior-grade plywood.
- G. Core Thickness: 3/4 inch.
  - 1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.
- H. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.
- I. Paper Backing: Provide paper backing on underside of countertop substrate.

## 2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
  - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
  - 1. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
  - 2. Softwood Plywood: DOC PS 1.

## 2.3 MISCELLANEOUS MATERIALS

- A. Adhesives: Do not use adhesives that contain urea formaldehyde.
- B. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - 1. Wood Glues: 30 g/L.
  - 2. Multipurpose Construction Adhesives: 70 g/L.
  - 3. Structural Wood Member Adhesive: 140 g/L.
  - 4. Architectural Sealants: 250 g/L.

## 2.4 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:

1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
- C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- D. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
1. Seal edges of openings in countertops with a coat of varnish.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and back priming.

#### 3.2 INSTALLATION

- A. Grade: Install countertops to comply with same grade as item to be installed.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
  1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.
  2. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
  1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

- D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- E. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- F. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  - 1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
  - 3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean countertops on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 123623.13

SCHEDULE OF MATERIAL SUBMITTALS <b>Architectural Submittals</b>												PROJECT NUMBER DMVA 42190067	PROJECT TITLE Fort Mifflin Bldg. 57 Building Renovation	SOLICITATION/CONTRACT NUMBER							
TO BE COMPLETED BY PROJECT ENGINEER												TO BE COMPLETED BY CONTRACT ADMINISTRATOR									
LINE NUMBER	ITEM OR DESCRIPTION OF ITEM, CONTRACT REFERENCE, TYPE OF SUBMITTAL	NUMBER OF COPIES REQUIRED										REQUIRED SUBMISSION DATE	DATE RECEIVED IN CONTRACTING	DATE TO CIVIL ENGINEERING	RETURN SUSPENSE DATE	SUBMITTAL NUMBERS	DATE CONTRACTOR NOTIFIED		CONTRACTOR RESUBMITTAL	FINAL APPROVAL	REMARKS
		CERTIFICATE OF COMPLIANCE	SHOP DRAWINGS	SAMPLES	COLOR SELECTION	MANUFACTURER'S RECOMMENDATIONS	MANUFACTURER'S WARRANTY	CATALOG DATA	OPERATING INSTRUCTIONS	Reports	Batch Slips						Steel Certifications	APPROVED			
1	054000 Load Bearing Metal Framing	X				X	X	X			X	NTP +30									
2	055213 Pipe and Tube Railing	X	X			X	X	X			X	NTP +30									
3	079200 Joint Sealant	X				X	X	X				NTP +30									
4	081113 Hollow Metal Doors and Frames	X	X			X	X	X	X		X	NTP +30									
5	083323 OH Coiling Doors	X	X			X	X	X	X			NTP +30									
6	087111 Door Hardware	X	X			X	X	X	X		X	NTP +30									
7	092900 Gypsum Board	X				X	X	X				NTP +30									
8	095123 Acoustical Tile Ceiling	X			X	X	X	X	X			NTP +30									
9	096513 Vinyl Wall Base	X		X	X	X	X	X				NTP +30									
10	097200 Wall Covering	X		X	X	X	X	X				NTP +30									
11	099123 Interior Paint	X			X	X	X	X				NTP +30									
12	099600 Epoxy Coatings	X		X	X	X	X	X	X			NTP +30									
13	101400 Signage	X			X	X	X	X	X			NTP +30									
14	102113 Toilet Compartments	X	X		X	X	X	X				NTP +30									
15	102800 Toilet Room Accessories	X				X	X	X				NTP +30									

SCHEDULE OF MATERIAL SUBMITTALS <b>Architectural Submittals</b>												PROJECT NUMBER DMVA 42190067	PROJECT TITLE Fort Mifflin Bldg. 57 Building Renovation	SOLICITATION/CONTRACT NUMBER							
TO BE COMPLETED BY PROJECT ENGINEER												TO BE COMPLETED BY CONTRACT ADMINISTRATOR									
LINE NUMBER	ITEM OR DESCRIPTION OF ITEM, CONTRACT REFERENCE, TYPE OF SUBMITTAL	NUMBER OF COPIES REQUIRED										REQUIRED SUBMISSION DATE	DATE RECEIVED IN CONTRACTING	DATE TO CIVIL ENGINEERING	RETURN SUSPENSE DATE	SUBMITTAL NUMBERS	DATE CONTRACTOR NOTIFIED		CONTRACTOR RESUBMITTAL	FINAL APPROVAL	REMARKS
		CERTIFICATE OF COMPLIANCE	SHOP DRAWINGS	SAMPLES	COLOR SELECTION	MANUFACTURER' S RECOMMENDATIONS	MANUFACTURER' S WARRANTY	CATALOG DATA	OPERATING INSTRUCTIONS	Reports	Batch Slips						Steel Certifications	APPROVED			
16	123623.13 Laminate Countertops	X	X		X	X	X	X				<b>NTP +30</b>									
17	As-Built drawings		X																		

SECTION 221110

PLUMBING PIPING

PART 1 GENERAL

1.1 STIPULATIONS

- A. The General Conditions, drawings and all other attached documents form a part of this Section and all other Sections by reference thereto and have the same force and effect as if printed herewith in full. The Contractor shall be strictly accountable for the cognizance of carrying out the provisions thereof.

1.2 SECTION INCLUDES

- A. The provisions and requirements of the following sections apply to work in this section.

1. Plumbing General

- B. Work in this Section includes the following:

1. Interior domestic water piping systems
2. Interior sanitary drainage piping systems
3. Fuel gas piping systems
4. Sleeves and floor plates
5. Supports, hangers, inserts and fasteners
6. Valves
7. Pipe insulation
8. Pipe identification
9. Valve tags
10. Utility marking tape

1.3 SUBMITTALS

- A. The Contractor shall submit manufacturer's catalog data for the following:
1. Interior domestic water piping systems
  2. Interior sanitary piping systems
  3. Fuel gas piping systems



4. Hangers and supports
5. Insulation
6. Valving
7. Plumbing piping Identification

#### 1.4 GAS UTILITY COMPANY COORDINATION

- A. The Contractor shall verify the requirements for the gas service with the Gas Utility Company before starting work.
- B. The Contractor shall include in his bid price the cost to obtain, furnish and install the gas meter regulators, associated concrete pads, piping, supports and valves required by the Gas Utility Company as a condition to provide service.

### PART 2 PRODUCTS

#### 2.1 INTERIOR DOMESTIC WATER PIPING (WITHIN 5 FEET OF BUILDING)

- A. Water piping above grade shall be Type "L" hard temper copper tubing conforming to ASTM B88, with cast bronze or wrought copper solder end fittings, conforming to ANSI B16.18, ANSI B18.24 or ANSI B16.22.
- B. Water piping below grade, 1/2 inch through 2-1/2 inches shall be Type "K" copper tubing with brazed cup depth sockets fittings ASNI/ASME B16.50. Water piping 3 inches and larger shall be Ductile Iron pressure pipe Class 52 cement lined with mechanical or push-on joint ANSI Spec. A21.51 with A21.11 gaskets and mechanical joint fittings.
- C. All solder joints in copper tubing shall be made with 95-5 tin-antimony solder. Use of lead solder will not be permitted.

#### 2.2 INTERIOR SANITARY AND STORMWATER DRAINAGE PIPING (WITHIN 5 FEET OF BUILDING)

- A. Above Ground Sanitary Waste, Vent Piping - Sanitary waste, vent inside buildings above ground shall be service weight cast iron conforming to ASTM A74/ASTM A888. Fittings shall be drainage pattern type. Pipe & Fittings shall be AB&I, Charlotte or Tyler and joints as manufactured by Clamp-all-125, Husky SD 4000 or MG. No-Hub piping shall be supported per CISPI Handbook Chapter IV. Threaded cast iron drainage fittings shall conform to ANSI B16.12. Type DWV hard drawn copper tube conforming to ASTM B306 with ANSI B16.29 DWV wrought copper or ANSI B16.23 cast copper fittings with 95-5 tin-antimony solder.
- B. Below Ground Sanitary Piping - All underground sanitary and rainwater conductor piping inside the building to a point 5 feet outside the face of exterior walls shall be service weight cast iron soil pipe conforming to ASTM A74. Extra heavy cast iron pipe shall be used where required by local code. Fittings shall be drainage pattern, neoprene compression type conforming to ASTM C 564.

#### 2.3 FUEL GAS PIPING

- A. Interior gas piping shall be Schedule 40 black steel pipe with malleable iron fittings and threaded joints. Underground piping and piping 4 inch and larger shall be Schedule 40 black steel with

forged steel butt welded fittings. Underground piping shall be factory coated with a resilient polyethylene sleeve; twenty-five (25) mils thick sealed to the pipe.

- B. Exterior underground piping may be SDR11 polyethylene, (PB2306/PE2405) conforming to ASTM D253, with heat fusion or mechanical joints, if acceptable to the gas company. Submit as a shop drawing, a letter from the gas company confirming their approval of this system.

## 2.4 VALVES

- A. All valves shall be products regularly produced for the specified service and rating in accordance with the manufacturer's catalog or engineering data. All valves shall be marked with the manufacturer's name or trademark. The recommended service pressure and the size, by letters and figures, cast or stamped on the body of the valve. Lead content in brass and bronze used in valves for plumbing systems shall not exceed eight (8) percent.

- B. Domestic Hot and Cold-Water Valves

- 1. Ball Valves

- a. 2-1/2-inch and Smaller - 600 psi WOG, lead free, full port, three-piece, bronze body, stainless steel ball and stem NIBCO T595Y Series, threaded end; Nibco S595Y Series, sweat ends.
    - b. 3-inch and Larger - Conventional port, three (3) piece, NIBCO S590Y or T590Y.

- 2. Fuel Gas Valves

- a. Gas Shutoff Valve - Gas valves shut off purposes shall be cast iron body eccentric action plug type with resilient plug facings composed of nitrile butadiene. 1/2 inch to 4-inch size shall be DeZurik Fig. 425 with lever operators. Greater than 4" size shall be handwheel actuated DeZurik Fig. 118.
    - b. Gas Solenoid Valve - Explosion proof, normally closed, with a NEMA 1 enclosure, UL listed gas solenoid valve. Aluminum body, Buna N seat and disc valve shall be rated for 120V operation. All switches, wiring, etc. for valve shall be provided as indicated in Division 16. Solenoid valve shall be ASCO Model 8215.

## 2.5 PIPE INSULATION

- A. All insulation shall have composite surface burning characteristic ratings as tested by ASTM E 84, UL 723, or NFPA 255 not exceeding:

- 1. Flame Spread 25
  - 2. Smoked Developed 50

- B. Composite shall include insulation, jacketing and adhesive used to secure jacketing or facing. All accessory items such as PVC Jacketing and Fittings, adhesive, mastic, cement, tape and cloth shall have the same component rating as specified above.

- C. Insulation shall be molded one (1) piece with a maximum thermal conductivity of 0.23 BTU-in./hr-sq. ft.-°F at seventy-five (75) degrees F mean temperature.

- D. Insulation shall be heavy density fiberglass, ASJ/SSL-II as manufactured by Owens-Corning Fiberglass Corp. Johns Manville or accepted substitute. Valve and fitting covers shall be Zeston 2000 PVC fitting covers as manufactured by Manville Co. Mastic sealer shall be Foster Tite-Fit Coating 30-35 as manufactured by H.B. Fuller Company.
- E. Closed cell foam insulation of 1 inch thickness or less may be substituted for fiberglass type sealed with compatible adhesives. Insulation shall be Model AP Armaflex as manufactured by Armstrong.

## 2.6 VALVE TAGS

- A. Tags shall be brass, 1" in diameter with large, stamped numerals and attached by a short link brass chain or brass "S" hook.

## 2.7 UTILITY MARKING TAPE

- A. Minimum 2 inches wide, metalized core plastic foil with the words "Caution - Pipeline Buried Below" printed in bold black letters.

# PART 3 EXECUTION

## 3.1 GENERAL

- A. All materials, equipment and accessories specified in this section shall be installed in strict accordance with the manufacturers' recommendations.

## 3.2 INSULATION

### A. Pipe Insulation

1. Piping to be insulated shall include all domestic water piping.
2. All insulation shall be applied in a workmanlike manner by skilled workmen regularly engaged in this type of work. Insulation shall be applied to clean and dry surfaces after tests and approvals required by this specification have been completed.
3. On cold surfaces where a vapor barrier must be maintained, 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.
4. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation.
5. All pipe insulation shall be continuous through walls, ceiling, floor openings, or sleeves; except where firestop or firesafing materials are required.
6. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed as required between the pipe and the insulation shields. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed.

- B. Insulation thicknesses shall conform to the PIPING INSULATION THICKNESS TABLE.

### PIPING INSULATION THICKNESS TABLE

<u>SERVICE</u>	<u>PIPE SIZE</u>	<u>INSULATION THICKNESS</u>
Domestic Cold Water	1/2" to 2"	1/2"
Domestic Cold Water	Larger than 2"	1"
Domestic Hot Water	1/2" to 1-1/4"	1/2"
Domestic Hot Water	1-1/2" to 2"	1"
Domestic Hot Water	Larger than 2"	1-1/2"

#### C. Application

1. Piping - All ends shall be firmly butted and secured with ASJ OR SSL butt strips of a minimum 3 inches wide. ASJ jacket laps and butt strips shall be secured by use of a suitable lap adhesive. Exposed end of pipe insulation shall be sealed with vapor retardant mastic at all fittings and valves.
2. Fitting and Valves - All fittings and valves shall be insulated with preformed fiber glass fittings, mitered sections of pipe insulation or fiber glass blanket. Insulation shall be of equal thickness to the adjacent pipe insulation.
3. Fitting and valves shall be further finished by applying PVC Fitting Covers. PVC covers shall be secured using solvent type PVC adhesive. All circumferential edges shall be further sealed by an overlap of at least 2 inches onto adjacent pipe insulation using PVC tape or ASJ/SSL butt strip material.

### 3.3 CATHODIC PROTECTION OF UNDERGROUND FUEL GAS PIPE

- A. All non-plastic underground fuel gas piping shall be cathodically protected. Provide a minimum of seventeen-pound magnesium anodes containing six percent (6%) aluminum and three percent (3%) zinc alloy. Anodes shall be distributed equally along the pipe run but spacing shall not exceed 100 feet between anodes. Each anode shall be attached to the pipe by the Caldwell and brazing process. The connecting wire shall be #12 A.W.G. copper with TW insulation. Each anode shall be repacked and shall be buried in backfill composed of seventy-five percent (75%) gypsum, twenty percent (20%) bentonite and five percent (5%) sodium sulphate. Wherever the underground gas piping rises above grade, provide an insulating dielectric fitting.

#### B. Utility Marking Tape

1. Install detectable utility marking tape above all outside pipelines, 12 inches to 18 inches below grade.

END OF SECTION

SECTION 221310

PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 STIPULATIONS

- A. The General Conditions, drawings and all other attached documents form a part of this Section and all other Sections by reference thereto and have the same force and effect as if printed herewith in full. The Contractor shall be strictly accountable for the cognizance of carrying out the provisions thereof.

1.2 SECTION INCLUDES

- A. Work in this Section includes the following:

- 1. Cleanouts
- 2. Floor Drains
- 3. Hose Bibbs
- 4. Freeze Proof Hose Bibb
- 5. Backflow Preventors
- 6. Water Hammer Arrestors
- 7. Water Meters
- 8. Gas Pressure Regulators

PART 2 PRODUCTS

2.1 CLEANOUTS

- A. Cleanouts shall be of coated cast iron construction with scoriated nickel bronze tops, (unless noted), vandal proof screws. Floor cleanouts shall be adjustable to finished floor after concrete is set. Cleanouts on exposed piping shall consist of threaded ferrules with threaded bronze plugs. Cleanouts shall be as manufactured by Jones Spec, Josam, J.R. Smith, Wade or Zurn.

- B. Cleanout types shall be as follows:

- 1. Finished Floor Cleanouts

Josam	
J.R. Smith	
Wade	W -6000-5
Zurn	ZN-1400-2

- 2. Wall Cleanouts

Josam

Smith  
Wade  
Zurn

ZANB-1468

## 2.2 FLOOR DRAINS

FD-1 Dura-coated cast-iron light duty floor drain with Type "B" 5-inch round nickel-bronze strainer, adjustable to finished floor. Floor drain shall be ZN-415-5B as manufactured by Zurn Industries, Inc. Wade 1100-TY-STDS-1

## 2.3 HOSE BIBBS

### A. HB-1 Hose Bibb

1. Angle pattern hose bibb consisting of a brass body, vacuum breaker-backflow preventor with 3/4-inch male hose thread nozzle, tee-handle and 3/4-inch copper water tube inlet. Hose bibb shall be Model 24C as manufactured by Woodford Manufacturing Co.

### B. FPHB-1 Frost Proof Hose Bibb

1. Concealed type, automatic draining wall hydrant consisting of a brass casting wall box and door with chrome finish, vacuum breaker-backflow preventor with 3/4-inch male hose thread nozzle, stainless steel operating stem and 3/4-inch copper water tube inlet. A loose tee key shall be furnished with each wall hydrant. Wall hydrant shall be Model B65C as manufactured by Woodford Manufacturing Co.

## 2.4 WATER HAMMER ARRESTORS

- A. Water Hammer Arrestors shall be of Type "L", Type "K" copper or stainless-steel bellows or plunger type construction conforming to PDI WH-201. Sioux Chief Series 650, PPP, Inc., Series SWA or SC, JR Smith, Josam, or Zurn.

## 2.5 WATER SUB-METER

A.

## 2.6 GAS PRESSURE REGULATORS

- A. Gas pressure regulators shall be diaphragm actuated with cast iron body, aluminum diaphragm chamber, and all internal parts designed for use with natural gas. Regulators shall be adjustable, with automatic loading, automatic low-pressure cut-off, and full internal relief. The regulator shall be adjusted for outlet pressure indicated on the drawings. The outlet pressure shall not vary more than 1-inch w.c. from the set point at specified capacity. The regulator shall be capable of complete shut-off in the event the supply pressure is interrupted, or the gas demand exceeds the regulator capacity and shall remain off until the regulator is manually reset. The regulator shall have a weatherproof, bug proof, screened vent cap installed in the vent tapping. Regulators shall be:

Regular	3/4" - 1-1/4"	1-1/2" - 2"
Rockwell	143-4	243-12-4
Fisher	1823B	-----
Singer	S-104	S-204
With Full Relief	3/4" - 1-1/4"	1-1/2" - 2"

Rockwell	143-6	143-12-6
Fisher	1883B	-----
Singer	S-106	S-206

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. All materials, equipment and accessories shall be installed in strict accordance with manufacturer's recommendations.
- B. Provide isolation valves for all fixtures, equipment, and accessories.
- C. All floor drains shall be flush with floor and per manufacturers recommendations.

#### 3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

#### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

#### 3.4 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION

## SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Flow-control, electric, tankless, domestic-water heaters.
  - 2. Domestic-water heater accessories.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Wiring Diagrams: For power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of tankless, electric, domestic-water heater, from manufacturer.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.



## 1.6 QUALITY ASSURANCE

- 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. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

## 1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Electric, Tankless, Domestic-Water Heaters: One year.

## PART 2 - PRODUCTS

### 2.1 ELECTRIC, TANKLESS, domestic-WATER HEATERS

- A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:
  - 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:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Eemax, Inc.
    - b. Chronomite Laboratories, Inc.
    - c. Bosch Water Heating.
  - 3. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.

4. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
  - a. Connections: ASME B1.20.1 pipe thread.
  - b. Pressure Rating: 150 psig.
  - c. Heating Element: Resistance heating system.
  - d. Temperature Control: Flow-control fitting.
  - e. Safety Control: High-temperature-limit cutoff device or system.
  - f. Jacket: Aluminum or steel with enameled finish or plastic.
5. Support: Bracket for wall mounting.

## 2.2 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket.
  1. Maintain manufacturer's recommended clearances.
  2. Arrange units so controls and devices that require servicing are accessible.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  5. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
  1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- C. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric,

domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

### 3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### 3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. 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.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain tankless, electric, domestic-water heaters.

END OF SECTION 223300

## SECTION 224000 – PLUMBING FIXTURES

### 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.
- B. This Section includes the following conventional plumbing fixtures and related components:
  - 1. Faucets for lavatories.
  - 2. Protective shielding guards.
  - 3. Fixture supports.
  - 4. Water closets.
  - 5. Urinals.
  - 6. Lavatories.
  - 7. Mop receptors.

#### 1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spout, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

### 1.3 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- C. Warranty: Special warranty specified in this Section.

### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- C. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

### 1.5 WARRANTY

- 1. Warranty Period for Commercial Applications: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 LAVATORY FAUCETS

- A. Lavatory Faucets, P-4:
  - 1. Product: Subject to compliance with requirements, provide product by one of the following:
    - a. Powers, A Watts Brand
    - b. Kohler Co.
    - c. Moen, Inc.
    - d. Or approved equal.
  - 2. Description: One-handle mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
    - a. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
    - b. Body Material: Commercial, solid brass.
    - c. Finish: Polished chrome plate.
    - d. Maximum Flow Rate: 0.5 gpm.

- e. Centers: 4 inches
- f. Mounting Type: Deck.
- g. Valve Handle(s): Single Lever Handle
- h. Inlet(s): NPS 1/2 male shank.
- i. Spout: Rigid.
- j. Spout Outlet: Vandal resistant spray head.
- k. Operation: Single pivoting handle.
- l. Drain: Grid.
- m. Tempering Device: Below the deck mechanical mixing valve, ASSE 1070 approved for temperature and pressure protection.

## 2.2 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Piping Enclosures, P-4:
  - 1. 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:
    - a. TRUEBRO, Inc.
    - b. Or Approved Equal.
  - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## 2.3 FIXTURE SUPPORTS

- 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. Smith, Jay R. Mfg. Co.
  - 2. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
  - 3. Zurn Plumbing Products Group; Specification Drainage Operation.
  - 4. Or Approved Equal.
- B. Urinal Supports, P-2:
  - 1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
  - 2. Accessible-Fixture Support: Include rectangular steel uprights.

## 2.4 FLOOR-MOUNTED WATER CLOSETS

- A. Water Closets, P-1,; Floor mounted, tank type.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
    - a. American Standard Companies, Inc.
    - b. Kohler Co.
    - c. Crane Plumbing, L.L.C./Fiat Products.
    - d. TOTO USA, Inc.

2. Bowl
  - 1) Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
  - 2) Material: Vitreous china.
  - 3) Type: Siphon jet.
  - 4) Style: Tank Type.
  - 5) Height: Standard or ADA.
  - 6) Rim Contour: Elongated.
  - 7) Water Consumption: 1.28 gal. per flush.
  - 8) Color: White.

## 2.5 URINALS

### A. Urinals, P-2:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
  - a. American Standard Companies, Inc.
  - b. Crane Plumbing, L.L.C./Fiat Products.
  - c. TOTO USA, Inc.
  - d. Or Approved Equal.
2. Description: Accessible, wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
  - a. Type: Siphon jet.
  - b. Strainer or Trapway: Open trapway with integral trap.
  - c. Rim Height (P-2): 24 inches above floor.
  - d. Rim Height (P-2A): 17 inches above floor.
  - e. Water Consumption: 0.5 gal./flush.
  - f. Spud Size and Location: NPS 3/4; top.
  - g. Color: White.
  - h. Outlet Size: NPT 2.
  - i. Flushometer: K-10675 WAVE DC 0.5 GPF Urinal Flushometer

## 2.6 LAVATORIES

### A. Lavatories P-4: VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
  - a. American Standard Companies, Inc.
  - b. Crane Plumbing, L.L.C.
  - c. TOTO USA, Inc.
  - d. Or Approved Equal.
2. Fixture:
  - a. Standard: ASME A112.19.2/CSA B45.1.
  - b. Type: Self-rimming for above-counter mounting.
  - c. Nominal Size: Oval, [19 by 17 inches (483 by 432 mm)] [20 by 17 inches (508 by 432 mm)] <Insert dimensions>.
  - d. Nominal Size: Round, [19 inches (483 mm)] <Insert dimension>.
  - e. Faucet-Hole Location: Top.

- f. Color: White.
- g. Mounting Material: Sealant.
- h. Faucet: Coralais® Centerset Bathroom Sink Faucet K-15182-4DRA
- i. Protective Shielding Guard(s): Truebro Lav Guard
- j. P-trap: K-8998-CP

## 2.7 MOP RECEPTOR

- A. Mop Receptor, P-5:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
    - a. Acorn Engineering Company.
    - b. Swan Corporation (The).
    - c. Zurn Plumbing Products Group; Light Commercial Operation.
  - 2. Description: Flush-to-wall, floor-mounting, cast-polymer fixture with rim guard.
    - a. Shape: Square.
    - b. Size: 24 by 24 inches.
    - c. Height: 10 inches.
    - d. Rim Guard: On all top surfaces.
    - e. Color: White.
    - f. Faucet: Sink Fiat 830-AA or approved equal. Chrome plated, back mounted, with wall support, vacuum breaker, hose threaded spout and bucket hook
    - g. Drain: Grid with NPS 3 outlet.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.



- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- J. Install toilet seats on water closets.
- K. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- L. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- M. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.
- N. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

### 3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

### 3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

### 3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

**END OF SECTION 224000**

SECTION 230510  
HVAC ELECTRICAL AND WIRING 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.
- B. The specification Section 230500 – COMMON WORK RESULTS FOR HVAC forms a part of this section and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 ELECTRICAL EQUIPMENT

- A. General:
  - 1. This Contractor shall furnish all motors, starters, for motors and controls for equipment under his Contract, unless otherwise noted.
  - 2. Electrical Contractor shall furnish & install all disconnects and overload protectors and shall provide all necessary wire, conduit and boxes to properly connect equipment for this Contractor no matter how many disconnects, etc. are included, unless otherwise noted.
  - 3. This Contractor shall provide all necessary conduit and control wiring to pushbuttons, thermostats, pilot lights, interlocks and similar equipment for this Contractors equipment.
  - 4. Flow control switches, thermostats and similar mechanical-electrical devices necessary for proper operation of mechanical systems shall be furnished and installed by this Contractor.
  - 5. Where the starter and/or safety switch is an integral part of the equipment assembly, the assembly shall be furnished with the wiring complete between starter, controller and motor. The Electrical Contractor will make connections to unit terminals.
  - 6. If motor control center is furnished (and installed) by Electrical Contractor for specific motors, the Mechanical Contractor shall not furnish starters for those specific motors, however the Mechanical Contractor shall furnish Electrical Contractor with starter requirements to insure proper operation of those motors.
  - 7. All motors and motor control equipment and wiring shall meet the requirements of the NEC and shall comply with the requirements of the Public Utility Company furnishing service and with the rules and regulations of all authorities having jurisdiction.

8. Voltage available at the building is 120/208 volts - three phase – four wires.
9. THIS CONTRACTOR SHALL VERIFY VOLTAGE AT SITE BEFORE ORDERING ANY ELECTRICAL EQUIPMENT.
10. The Electrical Contractor shall be responsible for proper rotation of three phase equipment.

## PART 2 - PRODUCTS

### 2.1 CONTROL WIRING

- A. All wiring and conduit shall be according to the latest edition of the NEC. All control wiring shall be installed in EMT, applicable portions of the NEC and of "DIVISION 16 - ELECTRICAL".
- B. Low voltage control wiring in air plenums shall be a UL approved conductor for application as manufactured by Alpha or Beldon.

## PART 3 - EXECUTION

### 3.1 CONTROL WIRING

- A. Workmanship on all phases of control wiring shall be equal to that of the Electrical Contractor and shall be performed by competent workmen.
- B. Horizontal cable runs shall be made level. Vertical cable runs shall be made plumb. Exposed cable runs shall run parallel or perpendicular to walls and ceilings, i.e., no unsightly diagonals or bends.
- C. In building equipment spaces, cables may be run along and strapped to the surface of walls using mechanical fasteners with wire ties.
- D. Horizontal cable runs shall be supported every 12 inches, and vertical cable runs shall be supported every 24 inches. Cables will be run in a workmanlike manner parallel to the floor with all droops removed by pulling taut but without exceeding the tensile strength of the conductors.
- E. Cable runs may not be run along or fastened to: any telephone cable superstructure, including those supported from the ceiling, from the wall, or on top of the telephone equipment frames; any air handling ductwork beyond fifteen feet from the supply or return fan; any fluid or gas piping.
- F. Cables shall be concealed unless permission is otherwise solicited from the Professional and granted in writing.

### 3.2 RESPONSIBILITIES

- A. The following is a list of equipment provided by this Contractor and shows both this Contractor's and the Electrical Contractor's responsibility for the furnishing, installing and connection of control, disconnecting and overload equipment.

- B. The conditions under Electrical Equipment, General (above) also apply to these paragraphs.
- C. Provide to the Electrical Contractor shop drawings, product data, and manufacturer's instructions for equipment furnished under DIVISION 23.
  - 1. Exhaust Fans
    - a. 120-volt, 1 phase.
    - b. Thermal overload switch, with pilot light, shall be provided by the Electrical Contractor.
    - c. Where indicated, light switches, or toggle switches with pilot lights, shall control fans. In these cases, thermal overload switches shall be provided and installed by the Electrical Contractor adjacent to the fan.

END OF SECTION

## SECTION 230515

### HVAC PIPING, MATERIALS, EQUIPMENT AND METHODS

#### Part 1 GENERAL

##### 1.1 STIPULATIONS

- A. The General Conditions, drawings and all other attached documents form a part of this Section and all other Sections by reference thereto and have the same force and effect as if printed herewith in full. The Contractor shall be strictly accountable for the cognizance of carrying out the provisions thereof.

#### Part 2 PRODUCTS

##### 2.1 GENERAL

- A. Furnish and install pipe, fittings, valves and accessories as shown on plans and/or as specified herein.
- B. Fittings and Joints
  - 1. All fittings 2" and under, unless otherwise specified, shall be screwed or solder type. All fittings 2-1/2" and larger shall be welded pipe fittings.
  - 2. All joints in pipe 2" and under unless otherwise specified, shall be screwed or solder couplings. All joints in pipe 2-1/2" and larger shall be butt welded.
  - 3. All pipe 2-1/2" and larger shall have their final connections to apparatus made with companion flanges. Pipes 2" and smaller shall be connected with screwed ground joint unions, unless otherwise specified, or noted on plans.
  - 4. The process known as "TEE DRILL" will not be an accepted method for the fitting and joining of piping.
- C. Piping: All piping shall follow the general arrangement shown and shall be accurately cut to measurements established from the work by the Contractor and shall be installed in place without springing or forcing. The location of all piping shall be such that a neat and workmanlike installation shall be secured. Provisions for expansion and contraction of all piping shall be made with approved means of expansion compensation.
- D. Piping Materials
  - 1. Gas Piping (LPG and/or Natural): All gas piping within the building shall be schedule 40 black steel pipe (ASA B36.10) with banded or beaded malleable iron fittings (except stop cocks and valves). Running threads, right and left couplings, cast iron fittings, or solder type fitting shall not be used.
    - a. Any underground gas piping shall be mill coated or plastic coated, as approved by the gas supplier, schedule 40 black steel pipe with welded joints and welding fittings and bends.

- b. The welding procedures and the quality of the welding shall conform to the procedures and processes in ASA Spec. B31-1.8-55 code for Pressure Piping for Welds on piping systems.

## 2.2 STEEL PIPING

- A. Governing Code: All piping shall be designed, fabricated and installed in accordance with the American Standard Code for Pressure Piping ANSI B31.1.
- B. Materials - Pipe: Welded or seamless pipe as required by the applicable section of the American Standard Code for Pressure Piping.
- C. Welding Fittings: U.S.A. factory made wrought carbon steel butt welding fittings conforming to ASTM Spec. A234 and ANSI Standard B16.9.
- D. Flanges: U.S.A. factory-forged flanges as follows: U.S.A. factory-forged flanges as follows: 150 lbs. and 300 lbs. classes per ASTM Spec. A181 and ANSI Standard B16.5
- E. Welding Electrodes for all Sizes: Electrodes for welding shall conform to ASTM A233.
- F. Gas Welding Rods for Sizes 4" and Smaller: Commercial steel gas welding rods per ASTM A251, GA60.

## 2.3 MATERIALS

### A. General

- 1. Where specification numbers are indicated, they shall include the latest amendment in effect at the date of this contract.
- 2. Each length of pipe and each pipe fitting, valve, etc., or device, used in this contract shall have stamped, cast or indelibly marked on it the maker's name or mark, the weight, type and class of product, when such marking is required by the approved standard that applies.

### B. Malleable Iron Fittings: Black or galvanized, IPS, conforming to ANSI Spec. B16.3.

### C. Unions

- 1. 2" and smaller - unions shall be provided adjacent to all equipment or wherever necessary to facilitate the removal of equipment for repair or replacement. Flange Unions - 2-1/2" and larger - forged steel, 150 lbs. conforming to ANSI Spec. B16.5.
- 2. Unions for steel pipe shall be ground joint, iron body with brass or bronze to iron seats, 150 lbs. working pressure.
- 3. Unions for copper pipe shall be ground joint, cast bronze.
- 4. No lip type unions or long screws shall be permitted.

### D. Sleeves, Floor Plates and Penetration Seals

- 1. All pipes passing through floors, walls or ceilings, shall be provided with a galvanized sheet steel sleeve and where exposed, shall have a chrome plated floor or ceiling plate securely fastened around each pipe as manufactured by Pipe Shields, Inc. or accepted equal.

2. All pipes passing through fire and smoke-rated walls and floor, and any smoke partition shall use Pipe Shields, Inc. (PSI) fire and smoke-rated wall and floor units or accepted equal. All assemblies shall have a 1- and 2-hour rating in accordance with the ASTM E119 test procedures. Packing materials between annular space and piping shall be UL rated ceramic fiber, Flameseal as manufactured by Nelson, or 3M Brand Fire Barrier CP25 WB.
3. Unless other indicated, sleeves shall be of such size as to provide a minimum of 1/4 inch all around clearance between bare pipe and sleeves or between jacket over insulation and sleeves.
4. Bare Pipe - PSI Model F3000 series.  
     Insulated Pipe  
     Return - PSI Model F1000 series.  
     Plastic Pipe - Bare or Insulated Lines - PSI Model F1800 series.
5. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheons shall be secured to pipe or pipe covering and shall be chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrew.
6. All pipes passing through fire-rated separations shall be sealed around sleeve and pipe with Flameseal as manufactured by Nelson or equal as accepted to provide a vapor tight seal and a 2 hour UL listed firestop.
7. All pipe through exterior wall or underground building penetrations shall be sealed with a positive hydrostatic seal. The modular mechanical seal assembly shall consist of interlocking rubber links shaped to fill the annular space between the pipe and steel wall sleeve. The seal shall be Link Seal Century Line Model CS100 with water stop and anchor plate at least 4" larger than the main outside diameter. The entire assembly seal and sleeve shall be sized and furnished by the Thunderline Corporation's authorized representative. The Link Seal shall be Model "C" for pipe design temperatures of +250 degrees Fahrenheit insulating type.

#### E. Pipe Hangers

1. Hangers for pipe up to 6" in diameter shall be carbon steel, electro-galvanized ASTM - Type LS, UL listed, FM approved, Model No. 10 as manufactured by Penn Construction Industries, ITT Grinnell Corporation or Milwaukee.
2. Where hangers support copper tubing, use Penn Construction Industries Fig. No. 10, with a complete polyvinyl coating bonded to and fused to ring to prevent contact with copper piping. Copper tubing lines shall not be (even temporarily) supported or secured to ferrous metals. Where copper tubing piping or fittings are anchored, supported, or may come in contact with metal construction, an insulating non-conductor spacer, similar to lead, rubber, fiber or an approved equal, shall be installed to assure prevention of electrolysis.
3. On pipe over 6" in diameter use Clevis ring Fig. 10WS or as required for copper piping.
4. Pipe hangers supporting insulated pipe shall be Penn Construction Industries No. 10WS.
5. Where two or more pipes run parallel the Contractor may use trapeze hangers made of 1-1/2" black steel pipe, ends capped. Hanger rods shall be 3/8" minimum for pipe sizes 1/2" to 1-1/4", 1/2" minimum for pipe sizes 1-1/2" to 3", 5/8" minimum for pipe 3-1/2" to 6", 7/8" minimum for pipe 8" to 12" and 1" for pipe 14" to 20".



6. All insulated piping will be protected at the point of support by pre-insulated pipe supports by Pipe Shields, Inc. (PSI), Insulshield or Uni-Grip. refrigerant lines - PSI Model CS-CW; all other insulated lines - PSI Model CS.
  7. When pipe hangers span greater than 10' and for all pipe roller application use PSI, CSX and CSX-CW (heavy duty units).
- F. Riser or Stack Clamps: Clamps shall be Grinnell 261, Michigan 510, Grabler 31 or accepted equal.
- G. Anchors: Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated.
- H. Electrolysis Control
1. When non-ferrous metallic tubing or piping is connected to ferrous piping, fittings or equipment, it shall be accomplished with the use of dielectric fitting or union, Model FX or GA as required as manufactured by Epco Sales, Inc., Clearflow fittings by Victaulic Co. of America, or accepted equal.
  2. An acceptable dielectric union, similar to Model GH as manufactured by Epco Sales, Inc., Clearflow fittings by Victaulic Co. of America, or acceptable, shall be installed on all copper pipelines leaving or entering building to arrest and retard electrolytic action.
  3. All dielectric unions shall contain Epconite #5 gaskets rated at 286°F indefinite time and 299°F for a ten-minute time limit.

## 2.4 VALVES

### A. General

1. All valves shall be products regularly produced for the specified service and rating in accordance with the manufacturer's catalog or engineering data. All valves shall be marked with the manufacturer's name or trademark, the recommended service, pressure, and size by letters and figures, cast on the body of the valves. Valve descriptions are taken from the Milwaukee Valve Company catalog or as otherwise noted equivalent products meeting the minimum standard of performance as set forth in the following.
2. Valve packing containing asbestos material will not be permitted.
3. Bronze gate and globe valve shall be equipped with an hexagon gland follower.
4. Valves, except check valves, shall be capable of being packed under pressure when wide open by means of a beveled back seat and bonnet.
5. Bronze valves shall be manufactured in U.S.A. to the extent possible and at least 90% of the manufacturer's total production. Manufacturers that do not own a U.S. foundry will not be considered as a United States manufacturer.

### B. Materials

The following is a composite list of valves, all valves may not be used on this project.

1. Natural Gas

a. 2 inch and smaller

(1). Class 175; semi-steel body; semi-steel, lubricated plug; wrench operated; screwed end.

Resun	R-1430
Nordstrom	142
Milwaukee	BB2-100

### Part 3 EXECUTION

#### 3.1 TESTING

##### A. General

1. This work shall include the testing of all piping and apparatus in the system for leaks, faulty joints, improper connections, etc. This Contractor shall notify the Department in sufficient time so that he can be represented for all tests.

#### 3.2 GAS PIPING

A. Unions shall be ground joint type and center punched to prevent loosening. Final connection to gas equipment may be made with AGA listed flexible or semi-rigid connectors and fittings. Where pipe is to be installed concealed in partitions or other generally inaccessible areas, the number of fittings shall be minimum. Unions and swing joints made of a combination of fittings shall not be used.

1. An approved cock or stop shall be accessibly installed ahead of each gas burning piece of equipment.
2. All piping shall be in accordance with the recommendations and requirements of the AGA, ASA Z21.30, and the gas supplier. This Contractor shall confer with the gas supplier before starting work and their instructions or recommendations on installation details shall be followed.

#### 3.3 STEEL PIPING

A. All pipe, fittings, and flanges shall be cleaned and thoroughly degreased before assembly.

#### 3.4 MATERIALS

A. Expansion Joints: Piping shall have guides on either side, four (4) pipe diameters and eighteen (18) pipe diameters from the joint.

##### B. Sleeves, Floor Plates and Penetration Seals

1. All pipes passing through floors, walls or ceilings, shall be provided with a galvanized sheet steel sleeve and where exposed, shall have a chrome plated floor or ceiling plate securely fastened around pipe as manufactured by Pipe Shields, Inc.
2. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members except where indicated or approved. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Unless otherwise indicated, sleeves shall be of such size as to provide a minimum of 1/4 inch all around clearance

between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe or cast-iron pipe. Sleeves in non-bearing walls, floors, or ceilings may be steel pipe, cast iron pipe, galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated, or moisture resistant fiber or plastic. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve shall be sealed as indicated and specified. Pipes passing through wall waterproofing membrane shall be sleeved as specified above, and a waterproofing clamping flange shall be installed.

3. Pipes passing through roof or floor waterproofing membrane shall be installed through a pipe portal curb. Portal shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane and sealed in a manner approved by the roof membrane manufacturer. The flashing sleeve shall extend up the pipe a minimum of 2 inches above highest flood level of the roof or a minimum of 10 inches above the floor. The annular space between the sleeve and the bare pipe or between the sleeve and the metal-jacket-covered insulation shall be sealed.
4. Escutcheons shall be provided at all finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.
5. This Contractor shall determine the required inside diameter of each wall opening or sleeve to fit the pipe and link seal. The link seal size and model shall be as recommended by the manufacturer to fit the pipe and wall opening. The Contractor shall install in strict accordance with the manufacturer's instructions. Ground side contact annular space around sleeve shall be grout sealed; interior or service side annular space around sleeve shall be caulked shut.

C. Piping: Piping shall be properly anchored to direct the expansion to bends or expansion joints.

D. Riser or Stack Clamps: Shall be installed wherever piping lines pass from one floor to another. Risers to be supported independently of connected horizontal piping.

E. Anchors: Anchors shall be provided where necessary or indicated to localize expansion or prevent undue strain on piping. Anchor braces shall be installed in the most effective manner to secure the desired results, using turnbuckles where required. Supports, anchors, or stays shall not be attached in places where they injure the construction during installation, or by the weight of or expansion of the pipeline.

F. Anchor Braces: The anchors shall be suitably fastened to the building construction so that they will not pull out of place nor impose adverse loads on the building structural members. Steel for anchors shall be provided by this Contractor.

### 3.5 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

Nominal Diameter	Steel Pipe Spacing	Rod Size	Copper Tubing	
			Spacing	Rod Size
1/2"	5'-0"	3/8"	5'-0"	3/8"
3/4"	6'-0"	3/8"	6'-0"	3/8"
1	7'-0"	3/8"	6'-0"	3/8"

Nominal Diameter	Steel Pipe Spacing	Rod Size	Copper Tubing	
			Spacing	Rod Size
1-1/4"	8'-0"	3/8"	7'-0"	3/8"
1-1/2"	10'-0"	3/8"	8'-0"	3/8"
2"	10'-0"	3/8"	9'-0"	3/8"
2-1/2", 3"	10'-0"	1/2"	10'-0"	1/2"

- B. Where unusually concentrated loads of valves and fittings occur, closer spacing shall be required. Submit specific cases for review and comments.
- C. Where piping changes direction, supports shall be placed in each direction adjacent to joints and no more than 12" from the joint.
- D. Piping larger than 16" shall be supported according to the details on the drawings.
- E. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
- F. Place a hanger within 12 inches of each horizontal elbow.
- G. Use hangers with 1-1/2-inch minimum vertical adjustment.
- H. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers. Hanger spacing shall be as scheduled above for the smallest pipe on the trapeze.
- I. Hangers shall be securely fastened to building construction. Where necessary, beam clamps, expansion bolts or through bolts and plates or concrete hooks shall be used. Wooden plugs shall not be permitted.

### 3.6 ELECTROLYSIS CONTROL

- A. The installation of non-ferrous metallic tubing on piping shall be accomplished in such a manner as to prevent it from coming in contact with ferrous metals. Where non-ferrous metallic tubing, piping or fittings are anchored, supported or may come in contact with ferrous metals, an insulating non-conducting spacer similar to rubber, fiber or other approved material, shall be installed to assure the prevention of electrolysis.
- B. Hangers supporting non-ferrous metallic tubing or piping shall be large enough to accommodate the insulation pipe covering. Non-ferrous metallic tubing or piping shall not be (even temporarily) supported or secured to ferrous metals.

### 3.7 VALVES

- A. General

1. Provide valves as shown on the drawings, herein specified or as required by code. To the extent possible, all valves shall be of one manufacturer.
2. Valves shall be located and arranged to ensure proper accessibility and operation.

END OF SECTION

## SECTION 230520

### HVAC SPECIALTIES

#### PART 1 GENERAL

##### 1.1 STIPULATIONS

- A. The General Conditions, drawings and all other attached documents form a part of this Section and all other Sections by reference thereto and have the same force and effect as if printed herewith in full. The Contractor shall be strictly accountable for the cognizance of carrying out the provisions thereof.

#### PART 2 PRODUCTS

##### 2.1 INSERTS AND FASTENERS

###### A. General

1. This section describes methods and materials for various standard types of construction for the guidance and establishment of the minimum requirements. However, if required, provide fasteners in modified form to suit other types of construction and adopt the method most applicable to the problem and with approval of the Professional.
2. Provide all required inserts or fasteners for the various types of construction encountered in the project. Hangers and inserts shall be in accordance with MSS-SP58, ASHRAE or SMACNA.
3. Inserts and fasteners hereinafter described shall be for hangers, supports, anchors, guides, braces, angle clips, brackets, controls, operators, drives, electrical controls, electrical devices, boxes, cabinets and equipment and fixtures. Inserts and fasteners shall be provided by the installing trade.

###### B. Inserts

1. Inserts shall be accurately located before the concrete is poured. Where loading exceeds the safe allowable limit for any single insert, then multiple inserts shall be installed, spaced no less than 12" on centers. The multiple inserts shall be connected with suitable size steel angles and locking bolts.
2. Inserts in poured concrete slabs shall be iron or fabricated galvanized iron or steel of the type to receive a machine bolt head or nut after installation and shall permit adjustment of this bolt in one horizontal direction.
3. When installed in cured concrete, inserts shall be capable of developing the full strength of bolt. Inserts shall be installed in such a manner that they be flush with the concrete surfaces, permit adjustment of the bolt in one direction and permit removal or insertion of the bolt or nut after the installation of the insert.
4. Where fastenings are required in poured concrete wall construction, inserts of the threaded connection type or galvanized bent end bolts shall be used, accurately set.

###### C. Fasteners

1. In cases where inserts have been inadvertently omitted or are required in existing construction, the fastening shall be accomplished by means of approved lead sheathed expansion bolts.
  - a. Wood plugs shall not be used in any case.
  - b. Expansion shields in pre-cast concrete slabs shall not be loaded more than 1/2 their maximum design capacity and never more than 200 pounds per bolt.
  - c. Where expansion bolts are spaced closer than one-foot centers, the multiple bolt shall be connected with suitable size steel angles and locking bolts or with single bolts extending through the slab above with a bearing plate.
  - d. Where finished floors occur, the welded plate and rod shall be recessed in the slab, finished in an approved manner.
2. Where roof plank with vegetable fiber admix or gypsum is used and the roofing supported by structural steel members or bar joists, it will be necessary to support piping, conduit, fixtures, ducts, devices, and equipment by suitable structural steel members, or fabricated support system spanning the roof, structural supports or by the use of single bolts extending through the slab above with a bearing plate, provided the plate does not affect the type of guarantee of the roofing and the load of the hanger and plate will not exceed a loading condition more than one-half (1/2) the designed roof loading.
3. Where roofing or floors are supported by structural steel members or bar joists, it will be necessary to support piping, conduit, devices, and equipment by suitable structural steel members, or fabricated supports.
4. Where guides or anchors are noted on the drawings, provision shall be made for the proper inserts or fastenings to structural members, deck or floor material.
5. Where fastenings are needed in masonry walls, bolts shall be galvanized U-bolts accurately set in the construction during erection. In cases where inserts have been inadvertently omitted, fastenings may be secured in the same manner as described for inadvertently omitted inserts.
6. Where fastenings are needed in steel stud, wire lath or other non-masonry construction, a "J" Hook and holding lock washer and nut shall be used and shall fasten to the opposite stud edge to which the item will abut. If the location of the fastening is not a steel stud, then a structural steel shape shall be fastened to the wall with bolt and holding nut with the fastening extension through the wall. The use of toggle bolts will not be permitted.
7. Where fastenings are needed in wood stud, wire lath or other non-masonry construction, backing boards shall be installed. Such backing boards shall be securely fastened and of sufficient size to have the connection near the center of the width. The supporting or fastening devices shall then be lag screwed to the backing boards. Lightweight items and similar items can be fastened by the use of wood screws. Direct fastening to wood studs will not be permitted.

## 2.2 ACCESS DOORS INTEGRAL WITH BUILDING STRUCTURE

### A. General

1. This Contractor shall furnish and install access doors to the General Contractor for installation in ceiling, walls, partitions and floors for access to valves, traps, balancing fittings, devices,

appurtenances, dampers, regulators, controls, and electrical controls or devices for code compliance so that full access for operation, inspection, and maintenance is assured.

2. The doors shall be of sufficient size to permit removal of item or clearance to perform maintenance, but in no case less than 12" x 16".

#### B. Installation

1. The location of all access doors shall be determined by the Contractor for whose work they are being provided.
2. Access doors shall be arranged so they can be integrated into the surface pattern, e.g. recessed panel with wire lath, security ceiling, masonry, or tile. Bottom of access doors shall not be lower than the top of base, or a minimum of 6" above floor. Tops and/or side of access panels shall be a minimum of 6" from the ceiling or opening or from the edge of a wall return.
3. Access doors are not required where ceilings are of the liftout removable tile type.

#### C. Product

1. Access doors in fire rated ceiling/floor and ceiling/roof assembly shall be "B-Label" and have a UL 1-1/2 hour (250 deg. F rating) for both door and frame. Maximum size shall be 20" x 20" or 400 square inches in area.
  - a. Frame - 16-gauge minimum steel.
  - b. Panel - 20-gauge minimum steel.
  - c. Paint - Prime coat of baked-on enamel.
  - d. Hinge - Continuous type, one per door.
  - e. Lock - Flush-face, key operated, self-latching cylinder locks.
2. Access doors without UL label
  - a. Frame - 16-gauge minimum steel.
  - b. Panel - 14-gauge minimum steel.
  - c. Paint - Prime coat of baked-on enamel.
  - d. Hinges - Concealed spring hinges. Door to open 175 degrees minimum.
  - e. Lock - Non-Security Areas: Flush-face, key operated, self-latching cylinder locks as specified in Section 08305 - Access Doors; Security Areas. Hardware shall be as specified in Division 11 - Security Access Panels.
3. All access doors shall be keyed alike and provided with casing beads, frame flange, or masonry anchor, as required, for mounting.
4. Identification label shall be attached to each access door as specified herein. Labels shall read FIRE DAMPER, SMOKE DAMPER or as required for each damper installation.



5. Frame and panel access doors in restrooms, kitchens and elsewhere indicated shall be stainless steel.

## 2.3 MISCELLANEOUS STEEL AND ACCESSORIES

- A. Design, Fabrication and Erection of the Structural and Miscellaneous Steel shall be in accordance with the "Design, Fabrication and Erection of Structural Steel Buildings" of the AISC, latest revision.
- B. All structural and miscellaneous steel shall conform to ASTM A36.
- C. High strength bolts shall conform to ASTM A325, and machine bolts shall conform to ASTM A307.
- D. Bolts shall be 3/4 inch in diameter with 13/16-inch diameter holes unless noted. All field connections shall be made with A325F (Friction-type) bolts unless noted.
- E. Beam connections shall develop the shear value equal to one half of its total uniform load capacity in accordance with the AISC Specifications for Frame Beam Connections, Table II, if shop welded, furnish in accordance with Table III.
- F. Welding shall be in accordance with the AWS D1.1 using E70XX electrodes.
- G. All steel shall receive a shop coat of a lead-free, rust-inhibitive primer.
- H. This Contractor shall provide all materials, equipment, supplies and labor necessary to construct all structural steel work shown on the drawings and as hereinafter specified, and as may be required for the installation of the equipment under this Contract.

## 2.4 VIBRATION ISOLATORS

### A. General

1. Furnish and install vibration isolators as hereinafter specified - all as manufactured by Amber/Booth Company, Vibration Eliminator Company, or Mason Industries, Inc. All model numbers listed below are referenced to Amber/Booth Company.

### B. Products

#### 1. Horizontal Pipe Runs

- a. All horizontal pipe runs within the boiler room area shall be isolated from building structure by means of units designed for insertion in rods. A/B Type BSR.
- b. hangers nearest equipment connections shall be of the "Load-transfer" type. A/B type PBSR.

#### 2. Vertical Pipe Risers

- a. The main anchoring point for high pipe risers shall be located at the lowest suitable level of the building capable of supporting the weight of the pipe and water. Locate auxiliary anchors immediately above expansion joints or on intermediate floors as required. The isolators supporting the base of the riser shall be a combination of a steel bearing plate on

top of a layer of 1/2" neoprene having a load capacity to 800#/sq. inch and provided with resilient sleeves and washers around each bolt anchoring the isolator to the structure. A/B type SP-NR-style C.

- b. The isolators supporting auxiliary anchors on upper floors shall be all-directional consisting of steel housed neoprene or combination of elastomer and laminated duct to which the pipe clamps are to be welded. For auxiliary anchors supporting steam and condensate lines, the isolators shall incorporate a 1/4" heat shield to protect the elastomer. A/B type AG.

### 3. Condensing Units

- a. Provide XL isolators for air-cooled condensing units.

### 4. Refrigerant Piping

- a. Refrigerant piping connections shall be made with flexible connectors at all equipment to eliminate vibration and noise.

### 5. Air Handling Units

- a. All ceiling suspended air handling units and fans shall be isolated with properly designed devices conforming to the efficiency requirements recommended by the manufacturer, but no deflection greater than 1-1/2" shall be required. A/B type BSR.
- b. All floor mounted air handling units shall conform to ceiling mounted units and shall be Type A/B Type SW-1.

## 2.5 FIRE STOPS

- A. Provide silicone or foam fire stopping material at pipe, ductwork, equipment, cable, and tubing penetrations in fire and smoke rated walls and floors. Fire stop material shall be applied to meet 2 hour fire rating. Fire stop material shall be Dow Corning Fire Stop Sealant, Dow Corning Fire Stop Foam, or accepted equal. Fire stop shall be applied in strict accordance with manufacturer's recommendations and instructions.

END OF SECTION

## SECTION 230553 – MECHANICAL IDENTIFICATION

### 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 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.3 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
  - 1. Equipment nameplates.
  - 2. Equipment markers.
  - 3. Pipe labels.
  - 4. Ductwork labels.

#### 1.4 SUBMITTALS

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

#### 1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
  - 1. Terminology: Match schedules as closely as possible.
  - 2. Data: Equipment Number.

3. Size: 1 x 4 inches for equipment.

## 2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semi rigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. 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: At least 1-1/2 inches high.

## 2.3 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- F. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
  1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  2. Lettering Size: At least 1-1/2 inches (38 mm) high.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

### 3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
  - 1. Roof Top Unit, Exhaust Fan, Make-Up Air and Energy Recovery Ventilator equipment.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
  - 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches
  - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
  - 3. Locate markers where accessible and visible.

### 3.3 PIPE LABEL INSTALLATION

- A. 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 for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit 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.

### 3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue: For supply ducts.
  - 2. Orange: For hot-air supply ducts.
  - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.5 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

END OF SECTION 230553

## SECTION 230590

### HVAC TESTING - ADJUSTING - BALANCING

#### PART 1 GENERAL

##### 1.1 STIPULATIONS

- A. The General Conditions, drawings and all other attached documents form a part of this Section and all other Sections by reference thereto and have the same force and effect as if printed herewith in full. The Contractor shall be strictly accountable for the cognizance of carrying out the provisions thereof.

##### 1.2 GENERAL

- A. This Contractor shall employ a qualified independent engineering testing firm as listed by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB) to execute all balancing operations on heating, ventilating, and air conditioning systems.
- B. The firm shall specialize in the field adjusting of heating and air conditioning systems, and shall not be associated with mechanical contractors, design engineering or equipment manufacturers or representatives.

#### PART 2 PRODUCTS

##### 2.1 GENERAL

- A. The agency or company must have operated as an independent test and balance agency for a period of not less than five (5) years immediately prior to the project issue for bid. During this five-year period, the agency must have continuously performed testing and balancing work as an agency - not as an individual.
- B. The agency must have an established place of business, separate and distinct from a home or residence.
- C. The applicant must maintain properly equipped and staffed facilities that are capable of compiling and distributing appropriate reports and data established from field measurements. These facilities must also be capable of furnishing the Professional with completely reliable documentation of system information.
- D. The agency must own the equipment necessary to perform the specified work herein.

##### 2.2 REQUIRED BASIC INSTRUMENTATION

- A. The agency or company must own the listed basic instrumentation.
- B. All equipment and instrumentation must be in good working order, tested and certified to be in correct calibration by an independent organization traceable to the National Bureau of Standards.
- C. Hydronic Differential Pressure Gauges
  - 1. 0 to 50 inches WG

2. 0 to 100 inches WG
3. 0 to 30 feet of water (or greater)

D. Anemometers

1. Rotating Vane
2. Deflecting Vane

E. Tachometer

1. Chronometric type

F. Pitot Tubes

1. 0 to 18"
2. 0 to 24"
3. 0 to 36"
4. 0 to 48"
5. 0 to 60"

G. Electric Meters

1. Portable volt-amp meter
2. Power factor meter

H. Flow Hood

I. Smoke Set

1. Gun
2. Candles

J. Sound Pressure Meter with Octave Band Analyzer

K. Thermometers

1. Glass stem
2. Dial
3. Pyrometer
4. Digital
5. Recording



L. Manometers

1. 0 to 10" inclined and vertical scale
2. 0 to 1" inclined scale
3. 0 to 0.25" inclined scale (0.005" increments)
4. 18" U-tube

M. Bourbon Tube Gauges

1. -30 Hg to 30 psi
2. 0 to 60 psi
3. 0 to 150 psi
4. 0 to 300 psi
5. Test gauge to verify other gauges

N. Air Differential Pressure Gauges (Magnetic Linkage)

1. 0 to 0.5" WG
2. 0 to 1.0" WG
3. 0 to 2.0" WG
4. 0 to 4.0" WG
5. 0 to 8.0" WG

### 2.3 CERTIFIED TEST AND BALANCE ENGINEER/TECHNICIAN QUALIFICATIONS

A. Engineer

1. The applicant must have in its employ, on a full-time basis, at least one AABC or NEBB Certified Test and Balance Engineer.
2. The person who is certified by AABC or NEBB as a Test and Balance Engineer must meet the following qualifications:
  - a. Education: The applicant must have submitted a resumé of educational background which has been approved as satisfactory by AABC and/or NEBB.
  - b. Experience:
    - (1). Not less than ten years test and balance experience.
    - (2). Five years of this must have been in continuous field experience in actual testing and balancing work. In addition, the applicant must pass the AABC examination for certification or accepted equivalent.

B. Test and Balance Technician Qualifications

1. The technician who is approved as an AABC or NEBB Qualified Test and Balance Technician must meet one of the following requirements:
  - a. Five years experience in Testing and Balancing and pass an AABC qualifying test or accepted equivalent.
  - b. Completion of the AABC Testing and Balancing Technician Apprentice Program and pass the AABC qualifying test or accepted equivalent.

PART 3 EXECUTION

3.1 GENERAL

- A. The firm shall employ a Professional Engineer registered in the Commonwealth of Pennsylvania who shall supervise the work. Said firm shall perform the following functions:
  1. Execute and forward to the consulting engineer a copy of a Warranty Certificate. Said certificate shall simultaneously be filed with this Contractor and the Professional and shall be a binding part of this Agreement.
  2. Execute the balancing of the air conditioning and ventilating systems to achieve appropriate air quantities at the appropriate terminals. (Recirculating hood systems shall be tested, balanced and adjusted for proper operation.)
  3. Check and calibrate new space thermostats in the renovated areas] for proper control.
  4. Enlist the cooperation of respective equipment manufacturers as necessary to achieve proper performance.
  5. All systems shall be balanced to within 10% of listed values. If balancer is unable to achieve these numbers, a report as to possible issues shall accompany the balancing report.
  6. Study and report any problem concerning noise which may develop in the course of system balancing.
- B. When work is complete, the firm shall report the results of the balancing and adjusting to the Professional on suitable forms, consistent with the requirements of the Professional. The Contractor shall supply six (6) copies of all balancing reports to the Professional for review.
- C. All of the work shall be performed in accordance with the National Standards for Field Measurements and Instrumentation -Total System Balance Volume 1 of the Associated Air Balance Council. In addition, the balancing firm shall recheck any specific terminals at the request of the Professional within the first year of operation.

END OF SECTION

SECTION 230713

HVAC DUCT INSULATION

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 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, concealed return.
  - 3. Indoor, concealed exhaust.
  - 4. Outdoor, concealed supply and return.
  - 5. Outdoor, exposed supply and return.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings.
  - 1. Detail insulation application at elbows, fittings, dampers, specialties, and flanges for each type of insulation.
  - 2. Detail application of field-applied jackets.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin and wrapped with a factory-applied FSK or ASJ jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.

### 2.2 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. 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.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
1. Products: Subject to compliance with requirements, provide one of the following]:
    - a. Aeroflex USA, Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.
- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armacell LLC; Tubolit.
    - b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aero seal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.K-Flex USA; R-373 Contact Adhesive.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. 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."
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. 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."
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

- c. P.I.C. Plastics, Inc.; Welding Adhesive.
  - d. Speedline Corporation; Polyco VP Adhesive.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. 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."

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
    - b. Eagle Bridges - Marathon Industries; 501.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
    - d. Mon-Eco Industries, Inc.; 55-10.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
  3. Service Temperature Range: 0 to 180 deg F.
  4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
  1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
  - b. Eagle Bridges - Marathon Industries; 570.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
- 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
  - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
  - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  - 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    - b. Eagle Bridges - Marathon Industries; 550.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    - d. Mon-Eco Industries, Inc.; 55-50.
    - e. Vimasco Corporation; WC-1/WC-5.
  - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 4. Solids Content: 60 percent by volume and 66 percent by weight.
  - 5. Color: White.

## 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
- 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    - b. Vimasco Corporation; 713 and 714.
  - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  - 4. Service Temperature Range: 0 to plus 180 deg F.
  - 5. Color: White.



## 2.6 SEALANTS

### A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
  - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
  - c. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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."

## 2.7 FACTORY-APPLIED JACKETS

### A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
    - b. Vimasco Corporation; Elastafab 894.

## 2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
- D. Metal Jacket:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.

- b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
  - c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
- a. Sheet and roll stock ready for shop or field sizing.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper thick polysurlyn.
- E. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Polyguard Products, Inc.; Alumaguard 60.

## 2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. ABI, Ideal Tape Division; 428 AWF ASJ.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
  - c. Compac Corporation; 104 and 105.
  - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. ABI, Ideal Tape Division; 491 AWF FSK.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
  - c. Compac Corporation; 110 and 111.
  - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ABI, Ideal Tape Division; 370 White PVC tape.
  - b. Compac Corporation; 130.
  - c. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ABI, Ideal Tape Division; 488 AWF.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
  - c. Compac Corporation; 120.
  - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## 2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch, 3/4 inch wide with wing seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; CD.
    - 3) Midwest Fasteners, Inc.; CD.
    - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CHP-1.
    - 2) GEMCO; Cupped Head Weld Pin.
    - 3) Midwest Fasteners, Inc.; Cupped Head.
    - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) GEMCO; Nylon Hangers.

- 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
  - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
  - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
    - 2) GEMCO; Peel & Press.
    - 3) Midwest Fasteners, Inc.; Self Stick.
  - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.
  
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; RC-150.
    - 2) GEMCO; R-150.
    - 3) Midwest Fasteners, Inc.; WA-150.
    - 4) Nelson Stud Welding; Speed Clips.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
  
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) GEMCO.
    - 2) Midwest Fasteners, Inc.
  
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
  
- D. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. C & F Wire.

## 2.12 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.

### 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. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor insulation, install insulation applications tightly joined to indoor insulation ends. Seal joint with joint sealant.



- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):  
Install insulation continuously through walls and partitions.
- C. Insulation Installation at Floor Penetrations:
  - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Seal penetrations through fire-rated assemblies.

### 3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 2. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins 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, place pins 16 inches o.c. each way and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not over compress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. 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.

### 3.7 FINISHES

- A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.

- B. Color: Final color as selected by Government Design Professional from manufacturer's full range. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Supply-Air Duct and Plenum Insulation:
  - 1. Mineral-fiber blanket, R-5 minimum.
  - 2. Mineral-Fiber Board: R-5 minimum.
- C. Return-Air Duct and Plenum Insulation:
  - 1. Mineral-fiber blanket, R-5 minimum.
  - 2. Mineral-Fiber Board: R-5 minimum.
- D. Exhaust-Air Duct and Plenum Insulation:
  - 1. Mineral-fiber blanket, R-5 minimum.
  - 2. Mineral-Fiber Board: R-5 minimum

### 3.10 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
  - 6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.

7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

### 3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed and exposed indoor and outdoor, round, flat-oval, and rectangular, supply-air and return-air duct insulation shall be the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
3. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
4. Polyolefin: 1 inch thick.

B.

### 3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed and Exposed:

1. PVC: 20 mils thick.
2. Aluminum, Smooth: 0.016 inch thick.
3. Painted Aluminum, Smooth: 0.016 inch thick.

### 3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

- C. Ducts and Plenums, Concealed and Exposed:
  - 1. [PVC]: 30 mils thick.
  - 2. Aluminum, Smooth: 0.020 inch thick.
  - 3. Painted Aluminum, Smooth: 0.020 inch thick.
  - 4. Stainless Steel, Type 304, Smooth 2B Finish: 0.016 inch thick.
  
- D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
  - 1. Aluminum, Smooth: 0.020 inch thick.
  - 2. Painted Aluminum, Smooth: 0.020 inch thick.
  - 3. Stainless Steel, Type 304, Smooth 2B Finish: 0.016 inch thick.

END OF SECTION 230713

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

1.2 DESCRIPTION

- A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.
- B. System software shall be based on a server/thin-client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network and (at the owner's discretion) over the Internet. The server shall also act as a "workstation" when running as a server/client platform. Additional clients shall have concurrent access to the "workstation" in this mode.
- C. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.
- D. System shall use BACnet protocol for communication between the control modules and web server. Communication between the web server and the user's browser shall be HTTP or HTTPS protocol utilizing HTML5. Use of Adobe Flash technology is not acceptable. I/O points, schedules, setpoints, trends, and alarms specified in the Sequence of Operations for HVAC Controls shall be BACnet objects.

1.3 APPROVED CONTROL SYSTEMS

- A. The following are approved control system suppliers, manufacturers, and product lines:
  - 1. Automated Logic Corporation, WebCTRL.
    - a. [randy.robertson@carrier.com](mailto:randy.robertson@carrier.com)
    - b. Cell 717-798-4066

1.4 ABBREVIATIONS

- A. The following abbreviations are utilized within this section and the sequences of operations. Refer to mechanical drawings for additional abbreviations.
  - 1. AC: Air Conditioning
  - 2. ACU: Air Conditioning Unit
  - 3. AHU: Air Handling Unit
  - 4. AHU: Air Handling Unit.
  - 5. AI: Analog Input

6. AO: Analog Output
7. ATC: Automatic Temperature Control.
8. BAS: Building Automation System.
9. CFM: Cubic Feet per Minute.
10. COND: Condenser
11. DA: Discharge Air
12. DDC: Direct-digital controls.
13. EA: Exhaust Air
14. EF: Exhaust Fan
15. EVAP: Evaporator
16. HVAC: Heating, Ventilating and Air Conditioning.
17. LAN: Local area network.
18. NC: Normally Closed
19. NO: Normally Open
20. OA: Outdoor Air
21. RA: Return Air
22. RF: Return Fan
23. RH: Relative Humidity
24. SA: Supply Air
25. SF: Supply Fan
26. SP: Static Pressure
27. TEMP: Temperature

#### 1.5 DEFINITIONS

- A. Adjustable (adj.): Adjustable by the end user, through the supplied user interface.
- B. Advanced Application Controllers (AACs): A fully programmable control module. This control module may be capable of some of the advanced features found in Building Controllers (storing trends, initiating read & write requests, etc.) but it does not serve as a master controller. Advanced Application Controllers may reside on either the Ethernet/IP backbone or on a subnet.
- C. Alarm: The control system shall be configured to generate an alarm when this object exceeds user definable limits, as described in the Sequence of Controls.
- D. Analog Value: An intermediate (software) point that may be editable or read-only. Editable AVs are typically used to allow the user to set a fixed control parameter, such as a setpoint. Read Only AVs are typically used to display the status of a control operation.
- E. Application Specific Controllers (ASCs): A pre-programmed control module which is intended for use in a specific application. ASCs may be configurable, in that the user can chose between various pre-programmed options, but it does not support full custom programming. ASCs are often used on terminal equipment such as VAV boxes or fan coil units. In many vendors' architectures ASCs do not store trends or schedules but instead rely upon a Building Controller to provide those functions.
- F. BACnet Interoperability Building Blocks (BIBB): A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a specification.

- G. BACnet/BACnet Standard: BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda.
- H. Binary Value: An intermediate (software) point that may be editable or read-only. Editable BVs are typically used to allow the user to set a fixed control parameter, such as a setpoint. Read Only BVs are typically used to display the status of a control operation.
- I. Building Controllers (BCs): A fully programmable control module, which is capable of storing trends and schedules, serving as a router to devices on a subnet, and initiating read and write requests to other controllers. Typically, this controller is located on the Ethernet/IP backbone of the BAS. In many vendors' architectures a Building Controller will serve as a master controller, storing schedules and trends for controllers on a subnet underneath the Building Controller.
- J. Control Systems Server: A computer(s) that maintain(s) the systems configuration and programming database.
- K. Controller: Intelligent stand-alone control device. Controller is a generic reference to building controllers, custom application controllers, and application specific controllers.
- L. Direct Digital Control: Microprocessor-based control including Analog/Digital conversion and program logic.
- M. Furnished or Provided: The act of supplying a device or piece of equipment as required meeting the scope of work specified and making that device or equipment operational. All costs required to furnish the specified device or equipment and make it operational are borne by the division specified to be responsible for providing the device or equipment.
- N. Gateway: Bi-directional protocol translator connecting control systems that use different communication protocols.
- O. Install or Installed: The physical act of mounting, piping or wiring a device or piece of equipment in accordance with the manufacturer's instructions and the scope of work as specified. All costs required to complete the installation are borne by the division specified to include labor and any ancillary materials.
- P. Integrate: The physical connections from a control system to all specified equipment through an interface as required to allow the specified control and monitoring functions of the equipment to be performed via the control system.
- Q. Interface: The physical device required to provide integration capabilities from an equipment vendor's product to the control system. The equipment vendor most normally furnishes the interface device. An example of an interface is the chilled water temperature reset interface card provided by the chiller manufacturer in order to allow the control system to integrate the chilled water temperature reset function into the control system.
- R. Local Area Network: Computer or control system communications network limited to local building or campus.
- S. Loop or control loop: Most commonly a PID control loop. Typically, a control loop will include a setpoint, an input which is compared to the setpoint, and an output which controls some action based upon the difference between the input and the setpoint. A PID control loop will also include gains for the proportional, integral, and derivative response as well as an

interval which controls how frequently the control loop updates its output. These gains may be adjustable by the end user for control loop “tuning,” but in self-tuning control loops or loops which have been optimized for a specific application the gains may not be adjustable.

- T. Master-Slave/Token Passing (MS/TP): Data link protocol as defined by the BACnet standard.
- U. Point-to-Point: Serial communication as defined in the BACnet standard.
- V. Primary Controlling LAN: High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below.
- W. Protocol Implementation Conformance Statement (PICS): A written document that identifies the particular options specified by BACnet that are implemented in a device.
- X. Router: A device that connects two or more networks at the network layer.
- Y. Schedule: The control algorithm for this equipment shall include a user editable schedule.
- Z. Trend: The control system shall be configured to collect and display a trend log of this object. The trending interval shall be no less than one sample every 5 minutes. (Change of Value trending, where a sample is taken every time the value changes by more than a user-defined minimum, is an acceptable alternative.)
- AA. Web Services: Web services are a standard method of exchanging data between computer systems using the XML (extensible markup language) and SOAP (simple object access protocol) standards. Web services can be used at any level within a Building Automation System (BAS), but most commonly they are used to transfer data between BAS using different protocols or between a BAS and a non-BAS system such as a tenant billing system or a utility management system.
- BB. Wiring: Raceway, fittings, wire, boxes and related items.

## 1.6 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications
  - 1. Installer shall have an established working relationship with the Control System Manufacturer and have, as a minimum, 5 years demonstrated experience with installation and support of the manufacturer’s product
  - 2. Installer shall have successfully completed Control System Manufacturer’s control system training. Upon request, Installer shall present record of completed training including course outlines.

## 1.7 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities’ codes and ordinances for these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
  - 1. National Electric Code (NEC)
  - 2. International Building Code (IBC)



- a. Section 719 Ducts and Air Transfer Openings
  - b. Section 907 Fire Alarm and Detection Systems
  - c. Section 909 Smoke Control Systems
  - d. Chapter 28 Mechanical
3. International Mechanical Code (IMC)
  4. ANSI/ASHRAE Standard 135, BACnet – A Data Communication Protocol for Building Automation and Control Systems

## 1.8 SYSTEM PERFORMANCE

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for display through the user's web browser.
  1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
  2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
  3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
  4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
  5. Alarm Response Time. An object that goes into alarm shall be annunciated at the browser within 45 sec.
  6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec.
  7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
  8. Multiple Alarm Annunciation. Each user, connected to network accessing the system through their browser (workstation), shall receive alarms within 5 seconds of one another.
  9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
    - a. Table 1: Reporting Accuracy
      - 1) Note 1: Accuracy applies to 10%–100% of scale
      - 2) Note 2: For both absolute and differential pressure
      - 3) Note 3: Not including utility-supplied meters

MEASURED VARIABLE	REPORTED ACCURACY
SPACE TEMPERATURE	±0.5°C (±1°F)
DUCTED AIR	±0.5°C (±1°F)
OUTSIDE AIR	±1.0°C (±2°F)
DEW POINT	±1.5°C (±3°F)
WATER TEMPERATURE	±0.5°C (±1°F)
DELTA-T	±0.15° (±0.25°F)
RELATIVE HUMIDITY	±5% RH
WATER FLOW	±2% OF FULL SCALE
AIRFLOW (TERMINAL)	±10% OF FULL SCALE (SEE NOTE 1)
AIRFLOW (MEASURING STATIONS)	±5% OF FULL SCALE
AIRFLOW (PRESSURIZED SPACES)	±3% OF FULL SCALE
AIR PRESSURE (DUCTS)	±25 PA (±0.1 IN. W.G.)
AIR PRESSURE (SPACE)	±3 PA (±0.01 IN. W.G.)
WATER PRESSURE	±2% OF FULL SCALE (SEE NOTE 2)
ELECTRICAL (A, V, W, POWER FACTOR)	±1% OF READING (SEE NOTE 3)
CARBON MONOXIDE (CO)	±5% OF READING
CARBON DIOXIDE (CO <sub>2</sub> )	±50 PPM

10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

a. Table 2: Control Stability and Accuracy

CONTROLLED VARIABLE	CONTROL ACCURACY	RANGE OF MEDIUM
AIR PRESSURE	±50 PA (±0.2 IN. W.G.) ±3 PA (±0.01 IN. W.G.)	0–1.5 KPA (0–6 IN. W.G.) –25 TO 25 PA (–0.1 TO 0.1 IN. W.G.)
AIRFLOW	±10% OF FULL SCALE	
SPACE TEMPERATURE	±1.0°C (±2.0°F)	
DUCT TEMPERATURE	±1.5°C (±3°F)	
HUMIDITY	±5% RH	
FLUID PRESSURE	±10 KPA (±1.5 PSI) ±250 PA (±1.0 IN. W.G.)	MPA (1–150 PSI) 0–12.5 KPA (0–50 IN. W.G.) DIFFERENTIAL

1.9 SUBMITTALS

- A. Product Data and Shop Drawings: Meet requirements of Section 01 30 00 on Shop Drawings, Product Data, and Samples. In addition, the contractor shall provide shop drawings or other submittals on hardware, software, and equipment to be installed or provided. No work may begin on any segment of this project until submittals have been approved for conformity with design intent. Drawings provided as electronic files on suitable solid-state media (file format: .PDF or comparable) and as 11” x 17” prints. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work.

B. Submittals shall include:

1. DDC System Hardware

- a. A complete bill of materials to be used indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
- b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
  - 1) Direct digital controllers (controller panels)
  - 2) Transducers and transmitters
  - 3) Sensors (including accuracy data)
  - 4) Actuators
  - 5) Valves
  - 6) Relays and switches
  - 7) Control panels
  - 8) Power supplies
  - 9) Operator interface equipment
  - 10) Wiring
- c. Wiring diagrams and layouts for each control panel. Show termination numbers.
- d. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware. Riser diagrams showing control network layout, communication protocol, and wire types.

2. Central System Hardware and Software

- a. A complete bill of material of equipment used indicating quantity, manufacturer, model number, and relevant technical.
- b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
  - 1) Central Processing Unit (CPU) or web server
  - 2) Monitors
  - 3) Keyboards
  - 4) Power supplies
  - 5) Battery backups

- 6) Interface equipment between CPU or server and control panels
  - 7) Operating System software – web server
  - 8) Color graphic software
  - 9) Third-party software
- c. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show interface wiring to control system.
  - d. Network riser diagrams of wiring between central control unit and control panels.
3. Controlled Systems
- a. Riser diagrams showing control network layout, communication protocol, and wire types.
  - b. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.
  - c. A schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
  - d. An instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
  - e. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
  - f. A point list for each control system. List I/O points and software points specified in the Sequence of Operations. Indicate alarmed and trended points.
4. Quantities of items submitted shall be reviewed but are the responsibility of the Contractor.
5. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.
- C. Project Record Documents. As-built documents shall be submitted for approval after final completion and shall include:
- 1. Project Record Drawings. As-built versions of submittal shop drawings provided as electronic files on suitable solid-state media (file format: .PDF or comparable) and as 11" x 17" prints.
  - 2. Testing and Commissioning Reports and Checklists.

3. Operation and Maintenance (O&M) Manual.
4. As-built versions of submittal product data.
5. Graphic files, programs, and database on suitable solid-state media.
6. List of recommended spare parts with part numbers and suppliers provided at the request of the owner.
7. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
8. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
9. Licenses, guarantees, and warranty documents for equipment and systems.
10. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions will be provided at the request of the owner.

D. Training Materials: Provide course outline and materials for each class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training.

#### 1.10 WARRANTY

A. Warrant work as follows:

1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
3. If the engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
4. Provide support related to web server software, project-specific software, graphic software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired and factory recertified. Installation labor and materials shall

be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.11 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
  - 1. Graphics
  - 2. Record drawings
  - 3. Database
  - 4. Application programming code
  - 5. Documentation

1.12 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Sensors and Transmitters:
  - 1. Airflow stations
  - 2. Flow Meters
  - 3. Flow switches
  - 4. Refrigerant pressure and temp sensor wells & sockets
  - 5. Hydronic Temp sensor wells and sockets
  - 6. H2O Pressure Differential/Flow Switches
- B. Control Valves:
  - 1. Control valves
- C. Control Dampers:
  - 1. Automated Dampers

1.13 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Field Installed Devices. HVAC equipment that is provided with packaged controls will be provided with all components necessary to complete the sequence of operations. Necessary components shipped loose from the equipment manufacturer shall be field installed by the ATC vendor.

1.14 PRODUCTS NOT FURNISHED OR INSTALLED UNDER BUT INTEGRATED WITH THE WORK OF THIS SECTION

- A. General: The Installer furnishing the DDC network shall meet with the Installer(s) furnishing each of the following products to coordinate details of the interface between these products and the DDC network. The Owner or his designated representative shall be present at this meeting.

Each Installer shall provide the Owner and all other Installers with details of the proposed interface including PICS for BACnet equipment, hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories. The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the DDC network. Submittals for these products shall not be approved prior to the completion of this meeting.

B. Central HVAC Equipment

1. Unit shall be furnished configured to accept control inputs from an external building automation system controller as specified in the sequence of operations. Factory mounted safeties and other controls shall not interfere with this controller.

C. Variable Frequency Drive

1. The variable frequency drive (VFD) vendor shall furnish VFDs with an interface to the control and monitoring points specified in the sequence of operations. These specified points shall be the minimum acceptable interface to the VFD. The connection to these points shall be by one of the following methods:
  2. Hardwired connection such as relay, 0-10VDC, or 4-20mA.
  3. BACnet/IP network connection.
  4. BACnet over ARCNET network connection.
  5. BACnet MS/TP network connection.
  6. Modbus MS/TP or IP is an acceptable alternative.

- D. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet interface for integration into the Direct Digital Control System described in this specification.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

### 2.2 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.
- B. Install new wiring and network devices as required to provide a complete and workable control network.

- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
  - 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
  - 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in the Sequence of Operations. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- E. Building Control Panels and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.
- F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.
- G. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards. Web services support shall as a minimum be provided at the workstation or web server level and shall enable data to be read from or written to the system.
  - 1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
  - 2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
  - 3. For read or write requests, the system shall require username and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.
  - 4. System shall support discovery through a Web services connection or shall provide a tool available through the Operator Interface that will reveal the path/identifier needed to allow a third-party Web services device to read data from or write data to any object in the system which supports this service.
  - 5. Direct access to trend data shall be provided in order to facilitate historical information stored by the system.

## 2.3 OPERATOR INTERFACE

- A. Hardware.



1. Server and workstation will be provided by the owner.
- B. System Software.
1. Operating System. Web server shall have an industry-standard professional-grade operating system. Operating system shall meet or exceed the DDC System manufacturer's minimum requirements for their software. Acceptable systems include Microsoft Windows 7, 8 or 10, Microsoft Vista, Windows Server 2008 or 2012, Red Hat Enterprise Linux, or Ubuntu Desktop 12.04.
  2. Security. The web server application shall support Transport Layer Security (TLS) with a capability of 256-bit encryption for transmitting private information over the Internet using HTTPS. Additionally, the web server shall have SHA-2 certificate support.
  3. Database. System shall support any JDBC (Java DataBase Connectivity) compliant engine. This includes: MS SQL, My SQL, PostgreSQL and Oracle.
  4. System Graphics. The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
    - a. Minimum graphics resolution shall be 1920 x1080 for display of detailed system graphics.
    - b. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
    - c. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
    - d. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
    - e. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in) or shall only require widely available no-cost plug-ins (such as Active-X or Adobe Flash).
  5. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system to create and modify graphics that are saved in the same formats as are used for system graphics.
  6. Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves,

pipng, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

- C. System Applications. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard PCs with no limit on the number of copies that can be installed under the system license.
1. Automatic System Database Configuration. Web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
  2. Manual Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
  3. System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password.
  4. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
  5. Online Video Training. Provide on-line video support to supplement on-line help assistance. Video content shall be relevant and support existing system documentation.
  6. Security. Each operator shall be required to log on to the system with a username and password in order to view, edit, add, or delete data.
    - a. Operator Access. The username and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users. System Administrators shall also be able to vary and deny each operator's privileges based on the geographic location, such as the ability to edit operating parameters in Building A, to view but not edit parameters in Building B, and to not even see equipment in Building C.
    - b. Password Policy Rules. System administrator shall invoke policies for minimum password strength, including number of characters, special characters and numbers, upper and lower case, etc.
    - c. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time shall be user adjustable.
    - d. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
  7. System Diagnostics. The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be annunciated to the operator.

8. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in the Sequences of Operations. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
9. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms or mnemonics.
10. Alarm Reactions. Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send SMS text, and audibly annunciate.
11. Alarm and Event log. Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms and archive closed alarms to the web server hard.
12. Trend Logs. The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in the Sequences of Operations. Trends shall be BACnet trend objects. As a minimum, all physical points in the system shall be trended within the local controller (AAC, ASC, BC) for at least 277 samples per point. Selected points, as desired, shall be available for historical archiving within the server. The historical archiving capability cannot be less than 2 years.
13. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object or property in the system. The status shall be available by menu, on graphics, or through custom programs.
14. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
15. Audit and Security Detail. All users accessing the system shall have their actions recorded. Information recorded shall include: login/logout time and date; system modifications – with before and after values; ability to report user activity based on individual and/or date and time.
16. Standard Reports. Furnish the following standard system reports:
  - a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
  - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.

- c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
  - 1) Alarm History.
  - 2) Trend Data. Operator shall be able to select trends to be logged.
- 17. Environmental Index. System shall monitor all occupied zones and compile an index that provides a numerical indication of the environmental comfort within the zone. As a minimum, this indication shall be based upon the deviation of the zone temperature from the heating or cooling setpoint. If humidity is being measured within the zone, then the environmental index shall be adjusted to reflect a lower comfort level for high or low humidity levels. Similarly, if carbon dioxide levels are being measured as an indication of ventilation effectiveness, then the environmental index shall be adjusted to indicate degraded comfort at high carbon dioxide levels. Other adjustments may be made to the environmental index based upon additional measurements. The system shall maintain a trend of the environmental index for each zone in the trend log. The system shall also compute an average comfort index for every building included in this contract and maintain trend logs of these building environmental indices. Similarly, the system shall compute the percentage of occupied time that comfortable conditions were maintained within the zones. Through the UI the user shall be able to add a weighting factor to adjust the contribution of each zone to the average index based upon the floor area of the zone, importance of the zone, or other static criteria.
- 18. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
- 19. Time Lapse Graphic Replay. Operator shall be able to “replay” any graphic in the system to see how key values changed over an operator-selected period of time. Operator shall be able to select the starting date/time for this display and the end date/time or the display period. System shall then display the graphic as it would have looked at the beginning of that period, displaying key data, dynamic colors, etc. based upon values recorded at the start time. When the operator starts the replay the graphics and key values shall dynamically change to produce the effect of “fast forwarding” through the designated period of time. Once the system has been operational for at least 30 days, the contractor shall demonstrate that up to 24 hours of data from within the last 30 days can be replayed on any graphic page. Owner’s representative shall choose the graphic pages for this demonstration at the time of the demonstration.

## 2.4 CONTROLLER SOFTWARE

- A. Furnish the following applications for building and energy management. All software applications shall reside and operate in the system controllers. Applications shall be editable through operator workstation, web browser interface, or workstation.
- B. Scheduling. Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:
  - 1. Weekly Schedule. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).

2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.
- C. Holiday Schedules. Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- D. Binary Alarms. Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.
- E. Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.
- F. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.
- G. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- H. Demand Limiting.
  1. The demand-limiting program shall monitor building power consumption from a building power meter (provided by others) which generates pulse signals or a BACnet communications interface. An acceptable alternative is for the system to monitor a watt transducer or current transformer attached to the building feeder lines.
  2. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in the Sequence of Operations. When demand drops below adjustable levels, system shall restore loads as specified.
- I. Maintenance Management. The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in the Sequence of Operations.
- J. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in the Sequence of Operations.
- K. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.

- L. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- M. Energy Calculations.
  1. The system shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
  2. The system shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
- N. Anti-Short Cycling. All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- O. On and Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.
- P. Runtime Totalization. Provide software to totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in the Sequence of Operations.

## 2.5 CONTROLLERS

- A. General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified. Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors
- B. BACnet.
  1. Building Controllers (BCs): Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L, and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
  2. Advanced Application Controllers (AACs): Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
  3. Application Specific Controllers (ASCs): Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
  4. Smart Actuators (SAs): An actuator which is controlled by a network connection rather than a binary or analog signal (0-10v, 4-20mA, relay, etc.). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ANSI/ASHRAE 135,

BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.

5. Smart Sensors (SSs): A sensor which provides information to the BAS via network connection rather than a binary or analog signal (0-10000 ohm, 4-20mA, dry contact, etc.). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.
6. BACnet Communication.
  - a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
  - b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
  - c. Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
  - d. Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
  - e. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
  - f. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.

C. Security.

1. Provide BACnet firewall capability, as defined in the BACnet standard, for controllers that are IP capable.

D. Communication.

1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
4. Stand-Alone Operation. Each piece of equipment specified in Section 23 09 93 shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or

other method for values normally read over the network such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.

- E. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
  - 1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at  $\square 29^{\circ}\text{C}$  to  $60^{\circ}\text{C}$  ( $\square 20^{\circ}\text{F}$  to  $140^{\circ}\text{F}$ ).
  - 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at  $0^{\circ}\text{C}$  to  $50^{\circ}\text{C}$  ( $32^{\circ}\text{F}$  to  $120^{\circ}\text{F}$ ).
- F. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- G. Memory.
  - 1. Controller memory shall support operating system, database, and programming requirements.
  - 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
  - 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- H. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- I. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

## 2.6 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Protection. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground shall cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no controller damage.
- C. Binary Inputs. Binary inputs shall allow the monitoring of ON/OFF signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.



- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall also accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall monitor low-voltage (0–10 Vdc), current (4–20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall provide for ON/OFF operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on Building Controllers have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- G. Analog Outputs. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0–10 Vdc or a 4–20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.
- J. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system

## 2.7 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
  - 1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
    - a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
    - b. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering.

1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
  - a. Dielectric strength of 1000 V minimum
  - b. Response time of 10 nanoseconds or less
  - c. Transverse mode noise attenuation of 65 dB or greater
  - d. Common mode noise attenuation of 150 dB or greater at 40–100 Hz

## 2.8 AUXILIARY CONTROL DEVICES

### A. Motorized Control Dampers, unless otherwise specified elsewhere, shall be as follow.

1. Type. Control dampers shall be the parallel or opposed-blade type as specified below or as scheduled on drawings.
  - a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
  - b. Other modulating dampers shall be opposed blade.
  - c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
2. Frame. Damper frames shall be galvanized steel channel or extruded aluminum with reinforced corner bracing.
3. Blades. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance.
4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 L/s·m<sup>2</sup> (10 cfm per ft<sup>2</sup>) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
6. Sections. Individual damper sections shall not exceed 125 cm × 150 cm (48 in. × 60 in.). Each section shall have at least one damper actuator.
7. Modulating dampers shall provide a linear flow characteristic where possible.
8. Linkages. Dampers shall have exposed linkages.

### B. Electric Damper and Valve Actuators.

1. Provide actuation as manufactured by Belimo and selected for applicable service.
2. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.

3. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
4. Signal and Range. Proportional actuators shall accept a 0–10 Vdc or a 0–20 mA control signal and shall have a 2–10 Vdc or 4–20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications)
5. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
6. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.
7. Zone Valve Actuators. For modulation of actuators in HVAC systems, actuator sizing should be in accordance with the valve manufactures' specifications. The actuator shall be powered by 24 volts AC. The actuator shall be controlled by commands from the terminal unit controller. Actuator shall be capable of modulating to any position as directed by the terminal unit controller. In addition, the actuator shall provide positive feedback to the terminal unit controller. The terminal unit controller actuator command is not considered positive feedback. Actuator shall be capable of providing fail open, fail close, or fail last position as determined by the project requirements.
  - a. Electronic Fail Safe is acceptable for terminal unit and zone valve applications

C. Temperature Sensors.

1. Type. Temperature sensors shall be thermistor (10k Type2).
2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5m (5 ft) in length per 1 m<sup>2</sup> (10 ft<sup>2</sup>) of duct cross-section.
3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
4. Space Sensors. Space sensors shall have setpoint adjustment, override switch, display, and communication port as shown.
5. Differential Sensors. Provide matched sensors for differential temperature measurement.

D. Humidity Sensors.

1. Duct and room sensors shall have a sensing range of 20%–80%.
2. Duct sensors shall have a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20%–95% RH and shall be suitable for ambient conditions of -40°C–75°C (-40°F–170°F).
4. Humidity sensors shall not drift more than 1% of full scale annually.

- E. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).
  - 1. Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
  - 2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- F. Relays.
  - 1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
  - 2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable  $\pm 100\%$  from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.
- G. Override Timers.
  - 1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0–6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.
- H. Current Transmitters.
  - 1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4–20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be  $\pm 1\%$  full-scale at 500-ohm maximum burden.
  - 2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
  - 3. Unit shall be split-core type for clamp-on installation on existing wiring.
- I. Current Transformers.
  - 1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
  - 2. Transformers shall be available in various current ratios and shall be selected for  $\pm 1\%$  accuracy at 5 A full-scale output.
  - 3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.
- J. Voltage Transmitters.

1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4–20 mA output with zero and span adjustment.
2. Adjustable full-scale unit ranges shall be 100–130 Vac, 200–250 Vac, 250–330 Vac, and 400–600 Vac. Unit accuracy shall be  $\pm 1\%$  full-scale at 500-ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

K. Voltage Transformers.

1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4°C–55°C (40°F–130°F) and shall provide  $\pm 0.5\%$  accuracy at 24 Vac and 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

L. Power Monitors.

1. Selectable rate pulse output for kWh reading, 4–20 mA output for kW reading, N.O. alarm contact, and ability to operate with 5.0-amp current inputs or 0–0.33-volt inputs.
2. 1.0% full-scale true RMS power accuracy, +0.5 Hz, voltage input range 120–600 V, and auto range select.
3. Under voltage/phase monitor circuitry.
4. NEMA 1 enclosure.
5. Current transformers having a 0.5% FS accuracy, 600 VAC isolation voltage with 0–0.33 V output. If 0–5 A current transformers are provided, a three-phase disconnect/shorting switch assembly is required.

M. Current Switches.

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

N. Pressure Transducers.

1. Transducers shall have linear output signal and field-adjustable zero and span.
2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4–20 mA output, suitable mounting provisions, and block and bleed valves.
4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and

maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4–20 mA output, suitable mounting provisions, and 5-valve manifold.

- O. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- P. Pressure-Electric (PE) Switches.
  - 1. Shall be metal or neoprene diaphragm actuated, operating pressure rated for 0–175 kPa (0–25 psig), with calibrated scale minimum setpoint range of 14–125 kPa (2–18 psig) minimum, UL listed.
  - 2. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application. Electrically rated for pilot duty service (125 VA minimum) and /or for motor control.
  - 3. Switches shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
  - 4. Each pneumatic signal line to PE switches shall have permanent indicating gauge.

## 2.9 LOCAL CONTROL PANELS.

- A. Indoor control cabinets shall be fully enclosed NEMA 1 construction with hinged door and removable subpanels.
  - 1. Terminal equipment enclosures will be constructed of lightweight durable metal with Lexan cover.
- B. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
- C. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

## 2.10 WIRING AND RACEWAYS

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

## 2.11 FIBER OPTIC CABLE SYSTEM

- A. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.

- B. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.
- C. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor’s work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor’s work with the work of others.

#### 3.2 PROTECTION

- A. The contractor shall protect all work and material from damage by his/her work or employees and shall be liable for all damage thus caused.
- B. The contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The contractor shall protect any material that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

#### 3.3 COORDINATION

- A. Site.
  - 1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment.
  - 2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Test and Balance.
  - 1. The contractor (if necessary) shall provide the T&B contractor with test and balance software and cable to interface to the control system for test and balance purposes.
  - 2. The contractor shall provide training in the use of these tools.
  - 3. The tools used during the test and balance process will be returned at the completion of the testing and balancing process.
  - 4. If interfacing capability cannot be provided, the contractor will assist the T&B contractor for the entirety of the test and balance process.

C. Life Safety.

1. Duct smoke detectors required for air handler shutdown are provided by others. Interlock smoke detectors to air handlers for shutdown as specified in the Sequence of Operations.
2. Smoke dampers and actuators required for duct smoke isolation are provided by others. Interlock smoke dampers to air handlers as specified in the Sequence of Operations.
3. Fire and smoke dampers and actuators required for fire-rated walls are provided by others. Fire and smoke damper control is provided by others.

3.4 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install equipment in readily accessible locations as defined by the National Electrical Code (NEC).
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.5 FIELD QUALITY CONTROL

- A. All work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section (Codes and Standards).
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

3.6 WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes, and electrical specifications. Where the requirements of this section differ from other divisions of this specification, the requirements of this section shall take precedence.
- B. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and electrical specification requirements.
- C. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be subfused when required to meet Class 2 current limit.
- D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended application.
- E. All wiring in mechanical, electrical, or service rooms – or where subject to mechanical damage – shall be installed in raceway at levels below 3 m (10ft).



- F. Do not install Class 2 wiring in raceways containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- G. Do not install wiring in raceway containing tubing.
- H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft) intervals.
- I. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- J. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- L. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.
- M. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- N. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- O. Size of raceway and size and type of wire shall be the responsibility of the contractor in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
- P. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- Q. Use color-coded conductors throughout with conductors of different colors.
- R. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- S. Conceal all raceways except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes or flues).
- T. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- U. Adhere to electrical specification requirements where raceway crosses building expansion joints.
- V. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.
- W. The contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

- X. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
- Y. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.

### 3.7 COMMUNICATION WIRING

- A. The contractor shall adhere to the items listed in the “Wiring” article in Part 3.7 of the specification.
- B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer’s installation recommendations for all communication cabling.
- C. Do not install communication wiring in raceways and enclosures containing Class 1 or other Class 2 wiring.
- D. Maximum pulling, tension, and bend radius for the cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- E. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.
- F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to manufacturer’s instructions.
- G. All runs of communication wiring shall be unspliced length when that length is commercially available.
- H. All communication wiring shall be labeled to indicate origination and destination data.
- I. Grounding of coaxial cable shall be in accordance with NEC regulations article on “Communications Circuits, Cable, and Protector Grounding.”
- J. BACnet Arcnet or MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:
  - 1. Arcnet
    - a. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 nominal. Distributed capacitance between conductors shall be less than 12.5 pF per foot (41 pF per meter.)
    - b. The maximum length of an Arcnet segment is 610 meters (2000 ft) with AWG 22 cable.
    - c. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.
    - d. An Arcnet network shall have no T connections.

2. MS/TP

- a. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot.)
- b. The maximum length of an MS/TP segment is 1200 meters (4000 ft) with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485
- c. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.
- d. An MS/TP EIA-485 network shall have no T connections.

3.8 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by wall framing.
- D. All wires attached to sensors shall be sealed in their raceways or in the wall to stop air transmitted from other areas from affecting sensor readings.
- E. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
- F. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1 ft. of sensing element for each 1 ft<sup>2</sup> of coil area.
- G. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 10 ft. downstream.
- H. All pipe-mounted temperature sensors shall be installed in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- I. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.
- J. Smoke detectors, low limit temperature sensors, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.
- K. Install humidity sensors for duct mounted humidifiers at least 10 ft. downstream of the humidifier. Do not install filters between the humidifier and the sensor.

### 3.9 FLOW SWITCH INSTALLATION

- A. Use correct paddle for pipe diameter.
- B. Adjust flow switch according to manufacturer's instructions.

### 3.10 ACTUATORS

- A. General. Mount and link control damper actuators according to manufacturer's instructions.
  - 1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
  - 2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
  - 3. Provide all mounting hardware and linkages for actuator installation.
- B. Electric/ Electronic
  - 1. Dampers: Actuators shall be direct mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° travel available for tightening the damper seal. Actuators shall be mounted following manufacturer's recommendations.
  - 2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

### 3.11 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within control panels, shall be labeled.
- B. All pneumatic tubing shall be labeled at each end within 2 in. of termination with a descriptive identifier.
- C. Permanently label or code each point of field terminal strips to show the instrument or item served.
- D. Identify control panels with minimum ½ in. letters on laminated plastic nameplates.
- E. Identify all other control components with labels.
- F. Control System Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- G. Identifiers shall match record documents.

### 3.12 CONTROLLERS

- A. Provide a separate controller for each AHU, or other HVAC system. A DDC controller may control more than one system provided that all points associated with the system are assigned to the same DDC controller. Points used for control loop reset, such as outside air or space temperature, are exempt from this requirement.

- B. Building Controllers and Custom Application Controllers shall be selected to provide the required I/O point capacity required to monitor all of the hardware points listed in the Sequence of Operation.

### 3.13 PROGRAMMING

- A. Provide sufficient internal memory for the specified sequences of operation and trend logging
- B. Point Naming. Name points as shown on the equipment points list provided with each sequence of operation. See Sequence of Operations. If character limitations or space restrictions make it advisable to shorten the name, the abbreviations given in the Sequence of Operations may be used. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, “Zone Temp 1” for Zone 1, “Zone Temp 2” for Zone 2.
- C. Operator Interface.
  1. Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as setpoints. As a minimum, show on each equipment graphic the input and output points and relevant calculated points as indicated on the applicable Points List in Section 23.
  2. The contractor shall provide necessary labor to start up and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

### 3.14 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner’s representative is notified of the system demonstration
  1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
  2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
  3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers’ recommendations.
  4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
  5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start, and span are correct, and that direction and normal positions are correct. The contractor shall

check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.

6. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops.
7. Alarms and Interlocks:
  - a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
  - b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
  - c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

### 3.15 CLEANING

- A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

### 3.16 TRAINING

- A. Provide (8) hours of onsite training for a designated staff of Owner's representatives.

### 3.17 START-UP AND CHECKOUT PROCEDURES

- A. Start up, check out, and test all hardware and software and verify communication between all components.
  1. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
  2. Verify that all analog and binary input/output points read properly.
  3. Verify alarms and interlocks.
  4. Verify operation of the integrated system.

END OF SECTION 230900

SECTION 233110

DUCTWORK, ACCESSORIES, AND SHEETMETAL SPECIALTIES

PART 1 GENERAL

1.1 STIPULATION

- A. The General Conditions, drawings and all other attached documents form a part of this Section and all other Sections by reference thereto and have the same force and effect as if printed herewith in full. The Contractor shall be strictly accountable for the cognizance of carrying out the provisions thereof.

PART 2 PRODUCTS

2.1 DUCTWORK

A. General

1. All duct dimensions listed on drawings are clear inside openings after insulation application.
2. All duct work passing through fire-rated or smoke separations protected by Halon shall be sealed around with Flame Seal as manufactured by Nelson, 3M Brand Fire Barrier CP25WB, or UL rated ceramic fiber as accepted, to provide a vapor tight seal and 2-hour UL listed fire stop.

B. Material

1. SMACNA has discontinued the use of the terms "low", "medium", "high" as applied to duct air velocity and or pressure classifications, however, for the purpose of this contract: low, medium, and high pressure ductwork shall be defined as follows, unless more stringent requirements are indicated on the drawings or specified herein.

**Classification: "LOW" PRESSURE DUCTWORK**

SMACNA Pressure Class	Operating Pressure	Velocity
1/2" w.g. pos. or neg.	Up to 1/2" w.g.	2000 fpm max.
1" w.g. pos. or neg.	Over 1/2" up to 1" w.g.	2000 fpm max.
2" w.g. pos. or neg.	Over 1" up to 2" w.g.	2000 fpm max.

**Classification: "MEDIUM" PRESSURE DUCTWORK**

SMACNA Pressure Class	Operating Pressure	Velocity
3" w.g. pos. or neg.	Over 2" up to 3" w.g.	2800 fpm max.
4" w.g. pos.	Over 3" up to 4" w.g.	2800 fpm max.
6" w.g. pos.	Over 4" up to 6" w.g.	2800 fpm max.

**Classification: "HIGH" PRESSURE DUCTWORK**

SMACNA Pressure Class	Operating Pressure	Velocity
-----------------------	--------------------	----------





3. Bracing angles generally shall be of the same material as the ducts or structural steel shapes. Bracing shall be riveted to duct 5" o.c.
4. Long radius elbows and transitions shall be used wherever possible. Where not possible, rectangular elbows may be used. Provide air foil turning vanes with rectangular or short radius elbows.
5. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.
6. Structural steel angle cradles or metal strips shall be used to support all ductwork as required for proper installation.

#### D. Duct Connection Systems

1. At the Contractor's option or where indicated on drawings, the Ductmate Duct Connection System manufactured by Ductmate Industries, Inc., and as specified herein, may be used as a method for connection sections of rectangular ductwork. Ductmate shall be used on round ducts in chase areas where indicated on drawings.
  - a. The Ductmate System shall result in the creation of a tight joint with zero leakage.
  - b. System shall be assembled and installed per manufacturer's instructions.
  - c. All component parts shall be of the composition and materials manufactured only by Ductmate Industries, Inc., and guaranteed against defective material and workmanship. If the Contractor desires to submit a substitute manufacturer, he shall provide full compliance report containing catalog data, test data, and engineering specifications, to the Professional for review.
  - d. The Ductmate System shall not be used for applications with duct gauges heavier than 16 gauge or lighter than 26 gauge.
  - e. Factory trained personnel shall be available upon the Contractor's request, at no charge, to instruct the Contractor in the use of the Ductmate System.

## 2.2 FLEXIBLE COLLARS

- A. Collars shall be approximately four (4") inches long, of the flexible, neoprene type.
- B. All materials shall have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E 84.

## 2.3 FLEXIBLE DUCT

### A. Material

1. Flexible duct for connection to diffusers shall be a factory fabricated assembly consisting of an inner sleeve, insulation and an outer moisture barrier. The inner sleeve shall be constructed of a continuous vinyl-coated spring steel wire helix fused to a continuous layer of Fiberglass impregnated and coated with vinyl. A 1-1/4" thick insulating blanket of Fiberglass wool shall incase the inner sleeve and be sheathed with an outer moisture barrier of a reinforced Mylar neoprene laminate of low permeability. The flexible duct shall be rated for a maximum

working velocity 2000 fpm (low pressure) and shall be listed by the Underwriters Laboratories under their UL-181 standards as Class 1 duct and shall comply with NFPA Standard 90A. All materials shall have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in ASTM E 84. The flexible duct shall be Thermaflex Model MK-E (low pressure).

#### 2.4 TURNING VANES

- A. Furnish and install turning vanes, where indicated on drawings.
- B. Vanes shall be High Efficiency Profile as manufactured by Tuttle & Bailey/Hart & Cooley, Cain Manufacturing Co., Inc., Duro Dyne Corp, or equal as accepted.

#### 2.5 BALANCING DAMPERS

- A. Balancing dampers shall be an opposed blade locking control type.
- B. Damper (when closed) shall have less than 1/2 of 1% leakage holding against 4" W.G. static pressure. Performance curves shall be based on 2000 fpm velocity.
- C. The frame shall be fabricated of heavy gauge galvanized steel, triple crimped for strength. The frame shall be welded construction throughout, except for operable blades shall pivot on half inch diameter cadmium plated, cold rolled steel stub shafts, in sintered bronze, self-lubricating bearings with one movable blade shaft extendable up to six inches.
- D. The blade linkage shall consist of 12 gauge galvanized steel clips on alternate rolled steel rod, and welded/riveted shaft end linkage, concealed in the jamb, connecting interim blades. The maximum blade width shall not exceed ten inches.
- E. Units with blade spans greater than 42 inches shall be made in multiple sections.
- F. The dampers shall be complete with mounting holes punched in the side frames on the blade centerlines.
- G. Dampers shall be as manufactured by Louvers and Dampers, Inc., Ruskin Manufacturing Co., or Arrow United.

#### 2.6 FIRE DAMPERS

- A. A sleeve gauge may not be less than shown for duct gauge as listed in NFPA Bulletin 90A, Latest Edition.
- B. All fire dampers shall have been tested under the STANDARD FOR FIRE DAMPERS UL -55- (latest edition) and shall be so labeled by UNDERWRITERS' LABORATORIES, INC. Dampers shall also be of the stacked blade design with the blade ends extended into the tracks at both jambs a minimum of 3/4". Dampers shall be UL listed for installation in a 2-hour fire stop. For locations where the damper is in the rectangular duct with an air flow velocity between 1000 and 2000 FPM, the nominal damper width shall be the same as the duct width but the blade stack (damper in open position), shall be out of the air stream (Type B damper). For locations involving round or flat oval duct, or rectangular with an air velocity exceeding 2000 FPM, the fire damper frame in the air stream (Type C damper). Mullions required for multiple damper installations shall have the same rating of the

dampers. Manufacturer's data shall show UL testing approval for both duct and ductless testing. Dampers shall be Air Balance Inc., Ruskin Manufacturing Company Inc., Prefco Products, Inc., and must meet applicable U.L. design numbers.

## 2.7 SPIN COLLARS

- A. For each flexible duct connection off of a main or branch duct to a ceiling diffuser and for each outlet off of the ventilation ductwork to the plenum air furnish and install a spin collar with a positive locking balancing damper.
- B. Spin collars shall be Type DESC for sheetmetal ductwork or Type FDESC for fiberglass ductwork as manufactured by Cleavflex Division of Clevapak Corporation, Type FLDE for sheetmetal ductwork of Type DBDE for fiberglass ductwork as manufactured by Flexmaster U.S.A., Inc., or equal as approved. In lieu of spin-in collars, this Contractor may, at his option, provide Buckley Air-Tite Bellmouth Model BM-D connectors with locking quadrant damper.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Where equipment furnished vary in dimensions, configuration, electrical characteristics, or location, etc., from the layout indicated on the drawings, the contractor shall make all modifications required to accommodate the actual equipment to be provided. Submission of shop drawings shall indicate acceptance of this responsibility. In any case an accurate 1/4" - 1'0" drawings shall be submitted with the shop drawings for approval by the professional prior to installation.
- B. All equipment shall be installed in a workmanlike manner by skilled workmen regularly engaged in this type of work.
- C. Where equipment is relocated to a place other than that shown on the drawings or when equipment other than that specified is used, the Contractor shall pay the entire cost of required revisions to such items as structural steel, concrete, electrical work, piping and ductwork.
- D. It is the full responsibility of this Contractor to ensure that the equipment he is providing fully conforms to this specification before submission to the Professional for review. This Contractor shall incur and shall be fully responsible for any and all costs associated with the equipment provided by a substitute manufacturer. Acceptance of the substitute manufacturer's equipment by the Professional will not relieve this Contractor of this responsibility.
- E. All ductwork as specified herein shall be internally lined, except the dishwasher exhaust ductwork, the kitchen hood make-up air system (on the downstream side of the make-up air system filters), or as otherwise noted on the project drawings or herein specified to be wrapped.
- F. The execution of the work shall be under the direct control and supervision of the insulation manufacturer or his authorized representative, in strict accordance with the manufacturer's instructions and recommendations, the best practice of the trade and the intent of these specifications.
- G. All devices shall be installed according to the best practices of the trade and the manufacturer's recommendations.

### 3.2 DUCT WORK

## A. General

1. Ducts, casings, fittings, transitions and accessories shall be made of galvanized sheet iron or steel and shall be installed in complete accordance with ASHRAE & SMACNA.
2. Provide flexible connections for all duct to equipment connections.
3. All ducts shall be strongly and rigidly constructed, and all joints and seams shall be mechanically tight as well as substantially and properly air tight. Sheet metal for slips and drive caps shall be of equal thickness and material as ducts.
4. Furnish and install access panels as previously specified under Section HVAC SPECIALTIES for concealed duct work.
5. Furnish and install duct access panels at all locations requiring access to:
  - a. dampers, all types
  - b. valves
  - c. control devices
  - d. fire alarm devices
  - e. at fifteen (15') feet on centers to permit duct cleaning
6. All duct work passing through fire-rated or smoke separators shall have the space between the wall and ductwork sealed.
7. Manufacturer's recommendations regarding product application and installation shall be strictly adhered to.
8. Special care shall be taken to construct, support and dress exposed ductwork neatly.

### 3.3 FLEXIBLE COLLARS

- A. Flexible (neoprene) collars shall be provided in all connections between fans and ducts or casings, where required, to prevent excessive movement of long ducts and wherever ducts cross building expansion joints.
- B. Collars shall be approximately four (4") inches long and shall be installed with just sufficient slack to prevent transmission of vibration. Circular collars shall be secured to fans and ducts with 12-gauge metal bands one (1") inch wide. Rectangular collars shall be secured to ducts and fans with 1 X 1/8" flat bars fastened with screws or bolts at eight (8") inch intervals or with slip joints similar to those specified for duct joints, the fabric being tightly crimped into the slip joint and the complete joint being fastened with sheet metal screws at eight (8") inch intervals. Collars shall not be painted. Metal for fastening collars shall be the same as specified for ducts and bracing.

### 3.4 FLEXIBLE DUCT

- A. All flexible duct runs shall not exceed 14 feet (or as shown less than 14 feet on project drawings) in length to comply with UL Standards for air ducts current addition of NFPA 90A-8. Where flexible duct runs exceed 14 feet on the drawings, the remainder shall be made up of round sheet metal and

insulated with lining as specified, gauges of round duct shall be as recommended by ASHRAE with bands and hangers attached to the building structure with straight runs and smooth radius.

1. All connections to rigid duct diffusers etc., shall be made with thimble, sleeves and connector as recommended by manufacturer.
2. Furnish and install spin-collars as specified under 15A3 - "Air Control Devices" for all flexible duct to sheet-metal duct connections.
3. Flexible ductwork shall be properly supported elbows per SMACNA standards and in no case laid unsupported over top of ceilings or crushed sections.

### 3.5 DUCTWORK ACCESSORIES

#### A. Turning Vanes

1. Furnish and install turning vanes, where indicated on drawings or as herein specified.

END OF SECTION

SECTION 23 34 00  
Overhead Fans

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. The ceiling-mounted circulation fan is the model scheduled with the capacities indicated. The fan shall be furnished with standard mounting hardware and variable speed control to provide cooling and destratification.

B. Summary of Work

1. Installation of the fan, miscellaneous or structural metal work (if required), field electrical wiring, cable, conduit, fuses and disconnect switches, other than those addressed in the installation scope of work, shall be provided by others. Factory installation services are available through Big Ass Fans. Consult the appropriate installation scope of work for information on the available factory installation options, overview of customer and installer responsibilities, and details on installation site requirements.

1.2 RELATED SECTIONS

- A. 23 05 10 HVAC Electrical Equipment and Wiring Requirements
- B. 26 05 00 Common Work Results for Electrical

1.3 REFERENCES

- A. National Fire Protection Association (NFPA)
- B. Underwriters Laboratories (UL)
- C. National Electrical Manufacturers Association (NEMA)
- D. National Electrical Code (NEC)
- E. Occupational Safety and Health Administration (OSHA)
- F. International Organization for Standardization (ISO)
- G. Nationally Recognized Testing Laboratory (NRTL)

1.4 SUBMITTALS

- A. Shop Drawings: Drawings detailing product dimensions, weight, and attachment methods.
- B. Product Data: Specification sheets on the ceiling-mounted fan, specifying electrical and installation requirements, features and benefits, and controller information.
- C. Revit Files: Files provided for architectural design.
- D. Installation Guide: The manufacturer shall furnish a copy of all operating and maintenance instructions for the fan. All data is subject to change without notice.
- E. Schedule

1.5 QUALITY ASSURANCE

A. Certifications

1. The fan assembly, as a system (with or without light kit), shall be Nationally Recognized Testing Laboratory (NRTL)-certified and built pursuant to the guidelines set forth by UL standard 507 and CSA standards 22.2 No. 60335-1 and 22.2 No. 113.
2. The fan assembly, as a system (with or without light kit), shall be CE- and UKCA-compliant.
3. The fan (with or without light kit) shall be compliant with NFPA 13—Standard for the Installation of Sprinkler Systems, NFPA 72—National Fire Alarm and Signaling Code, and NFPA 70—National Electrical Code (NEC).
4. Controllers shall comply with National Electrical Code (NEC) and Underwriters Laboratories (UL) standards and shall be labeled where required by code.

5. The optional occupancy sensor shall be CE-compliant and UL and cUL listed.
- B. Manufacturer Qualifications
  1. The fan and any accessories shall be supplied by Big Ass Fans, which has a minimum of twenty (20) years of product experience.
  2. ISO 9001 compliant
  3. The manufacturer shall not be listed on the Air Movement and Control Association International Inc. (AMCA) Certified Ratings Program (CRP) Non-Licensed Products report in the previous 36 months.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver product in original, undamaged packaging with identification labels intact. The fan shall be new, free from defects, and factory tested.
- B. The fan and its components must be stored in a safe, dry location until installation.

1.7 WARRANTY

- A. The manufacturer shall replace any products or components defective in material or workmanship for the customer free of charge (including transportation charges within the USA, FOB Lexington, KY), pursuant to the complete terms and conditions of the Big Ass Fans Warranty in accordance to the following schedule:

Mechanical†	15 years
Electrical†† install††††)	7 years (no factory install†††); 15 years (factory
Labor	1 year

- † "Mechanical" is defined as mechanical components of the fan, including the gearbox, fan hub, motor frame, mounting, airfoils, and winglets.
  - †† "Electrical" is defined as electrical and electronic components of the fan, including the motor, motor drive, variable frequency drive, and any standard controller or accessories.
  - ††† The No Factory Install Warranty Period defined above for "Electrical" applies to proper installations by any other state-qualified or licensed electrical contractor.
  - †††† The Factory Install Warranty Period defined above for "Electrical" requires installation to be purchased from Big Ass Fans and performed by a factory-approved, Big Ass Fans Certified Installer.
  - ††††† The Warranty Period for light kits is limited to 1 year (parts).
  - †††††† All reasonable costs of repair or replacement will be paid or reimbursed provided customer obtains pre-approval.
  - ††††††† The Warranty period for any manufacturer defects or flaws to surface finishes is limited to 1 year.
  - †††††††† All products are considered for indoor use only unless specifically specified on the product label.
  - ††††††††† See the complete warranty for more details.
- B. The warranty shall not require the submission of a post installation form or photographs of the installed fan(s) to the manufacturer for the warranty to be in effect.
  - C. The warranty shall not require the periodic submission of maintenance records for the warranty to remain in effect.

PART 2 PRODUCT

2.1 MANUFACTURER

- A. Delta T LLC, dba Big Ass Fans, PO Box 11307, Lexington, Kentucky 40575.  
Phone (877) 244-3267. Fax (859) 233-0139. Website: [www.bigassfans.com](http://www.bigassfans.com)
- B. Or Approved Equal

2.2 HIGH VOLUME, LOW SPEED FANS – BIG ASS FANS POWERFOIL®X3.0 & POWERFOIL®X3.0 PLUS

## A. Complete Unit

### 1. Regulatory Requirements:

- a. The entire fan assembly (with or without light kit) shall be NRTL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standards 22.2 No. 60335-1 and 22.2 No. 113.
- b. The controller shall be compliant with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) The device may not cause harmful interference, and (2) The device must accept any interference received, including interference that may cause undesirable operation.

### 2. Sustainability Characteristics:

- a. The fan shall be designed to move an effective amount of air for cooling and destratification in a variety of applications (including industrial and agricultural) over an extended life. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 55 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.
- b. The BAFCon controller shall be designed to control Big Ass Fans and lighting systems from a secure, centralized location. The system shall be designed specifically for high volume, low speed Big Ass Fans to ensure maximum control. The system shall include optional SmartSense functionality to maximize energy savings. SmartSense shall provide the capability to automatically control the speed of Big Ass Fans using information from user-determined settings and built-in temperature and humidity sensors.

3. Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.

## B. Onboard Fan Control

1. The onboard fan controller shall be constructed using a variable frequency drive (VFD) that is pre-wired to the motor and factory-programmed to minimize the starting and braking torques for smooth and efficient operation. The onboard controller shall be prewired to the motor using a short run of flexible conduit with a dedicated ground conductor to minimize electromagnetic interference (EMI) and radio frequency interference (RFI). A 15-ft incoming power cord shall be pre-wired to the controller with one of the following plugs: NEMA L6-20P Twist-Lock Plug, NEMA L6-30P Twist-Lock Plug, NEMA L15-20P Twist Lock Plug, NEMA L16-20P Twist-Lock Plug.

## C. Airfoil System

1. The fan shall be equipped with six (6) Powerfoil airfoils of precision extruded aluminum alloy. The airfoils shall be connected by means of two (2) high strength locking bolts per airfoil. The airfoils shall be connected to the hub and interlocked with zinc plated steel retainers.
2. The fan shall be equipped with six (6) Powerfoil winglets (standard) or six (6) Powerfoil Plus winglets (optional) on the ends of the airfoils and six (6) AirFences® positioned on the airfoils at the optimum location for performance. Both the winglets and AirFences shall be molded of a polypropylene blend. The standard color of the winglet and AirFence shall be "BAF Yellow."
3. Airfoil Restraint System
  - a. All 20- to 24-ft (6- to 7.3-m) diameter fans shall be equipped with a patented airfoil restraint system to provide redundant safety between the ends of the airfoils and the fan hub. The airfoil restraint system shall be available as an option on smaller diameter fans.
  - b. The airfoil restraint system shall be comprised of durable, lightweight nylon safety straps that shall extend from winglets through the airfoils and secure to the fan hub with 12-gauge stamped steel safety clips.
  - c. The straps shall be made of 1 in. (24 mm) wide heavy-duty nylon webbing rated for 825 lb (374 kg). The loops at the ends of the straps shall be secured in a double-stitch pattern for reinforced durability.
  - d. The straps shall be precisely matched to each fan's diameter, eliminating the need for a tensioning mechanism and reducing opportunity for noise.
  - e. The straps shall run along the inside of the airfoils for an uninterrupted look.



- f. Safety clips shall secure to each winglet to comprise the outer anchor points and provide tension, while clips on the opposite end shall secure to threaded inserts incorporated in the fan hub.
- D. Motor
- 1. The fan motor shall be an AC induction type inverter rated at one of the following:
    - a. 1725 RPM, 200–240/400–480 VAC, 50/60 Hz, three-phase, 1.5 hp
    - b. 1725 RPM, 200–240/400–480 VAC, 50/60 Hz, three-phase, 2 hp
  - 2. The motor shall be totally enclosed, fan cooled (TEFC) with an IP44 NEMA classification. A NEMA 56C standard frame shall be provided for ease of service. The motor shall be manufactured with a double baked Class F insulation and be capable of continuous operation in 32°F to 122°F (0°C to 50°C) ambient conditions.
  - 3. The motor shall have a C-face attachment that shall enable technicians to detach the motor for easy field service. The C-face motor adapter shall be designed to work with the NitroSeal™ gearbox.
  - 4. As an option, the architect or owner may upgrade to the “harsh environment package,” which includes a motor with an IP55 NEMA classification. As part of the “harsh environment package,” the onboard VFD enclosure is sealed for weather-resistant operation.
- E. Gearbox
- 1. The fan gearbox shall be a NitroSeal™ Drive designed specifically for the Powerfoil X series. The gearbox shall include a high-efficiency, hermetically sealed, nitrogen-filled, offset helical gear reducer with two-stage gearing, a hollow output shaft, cast iron housing, double lip seals, high quality SKF Explorer Series bearings with crowned cages for optimal lubrication flow, and precision machined gearing to maintain backlash less than 11 arc-minutes over the life of the unit. Lubrication shall be high-grade, low-foaming synthetic oil with extreme pressure additives and a wide temperature range and shall be lubricated for the life of the product (no oil changes required).
  - 2. The gearbox shall be equipped with a hollow shaft threaded to accept a ¾” NPT fitting in which wiring, piping, etc., can be routed to below the fan. A standard junction box can be affixed to this hollow shaft to allow for installing optional features such as lights or cameras. The inclusion of the hollow shaft shall be specified at the time of order.
- F. Mounting Post
- 1. The fan shall be equipped with a mounting post that provides a structural connection between the fan assembly and extension tube. The mounting post shall be formed from A36 steel, contain no critical welds, and be powder coated for corrosion resistance and appearance.
- G. Mounting System
- 1. The fan mounting system shall be designed for quick and secure installation on a variety of structural supports. The design of the upper mount shall provide two axes of rotation. This design shall allow for adjustments to be made after the mount is installed to the mounting structure to ensure the fan will hang level from the structure.
  - 2. The upper mount shall be of ASTM A-36 steel, at least 3/16” thick, and powder coated for appearance and corrosion resistance. No mounting hardware or parts substitutions, including cast aluminum, are acceptable.
  - 3. All mounting hardware shall be SAE Grade 8 or equivalent.
- H. Hub
- 1. The fan hub shall be 19” (48 cm) in diameter and shall be made of precision cut aluminum for high strength and light weight. The hub shall consist of two (2) aluminum plates, eight (8) aluminum spars, and one (1) aluminum spacer fastened with a pin and collar rivet system. The overall design shall provide a flexible assembly such that force loads experienced by the hub assembly shall be distributed over a large area to reduce the fatigue experienced at the attachment point for the fan blade.
  - 2. The hub shall be secured to the output shaft of the gearbox by means of ten (10) high strength bolts. The hub shall incorporate four (4) safety retaining clips made of 1/4” (0.6 cm) thick steel that shall restrain the hub/airfoil assembly.
- I. Safety Cables

1. The fan shall be equipped with an upper safety cable that provides an additional means of securing the fan assembly to the building structure. The upper safety cable shall have a diameter of Ø3/8" (1 cm).
  2. The fan shall be equipped with two lower safety cables pre-attached to the fan hub that shall provide an additional means of securing the fan to the extension tube. The lower safety cables shall have a diameter of 1/4" (0.6 cm).
  3. The safety cables shall be fabricated out of 7 x 19 galvanized steel cable. The end loops shall be secured with swaged Nicopress® sleeves, pre-loaded and tested to 3,200 lbf (13,345 N).
  4. Field construction of safety cables is not permitted.
- J. Digital Variable Speed Wall Controller
1. The fan shall be equipped with a digital variable speed wall controller. The user interface shall be an intuitive touchscreen interface.
  2. The controller shall be mounted to a standard rectangular or square outlet box.
  3. A 150-ft (45.7-m) CAT5 cable shall be provided for connecting the controller to the fan's VFD and to provide power to the controller.
  4. The controller mounting location shall meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.
  5. The controller shall have an IP55 rating.
  6. The controller shall provide fan start/stop, speed, and direction control functions.
  7. The controller shall provide diagnostic and fault history information for the connected fan, as well as the ability to configure fan parameters with the assistance of Big Ass Fans Customer Service.
  8. The controller interface shall be able to be secured with a passcode to prevent unauthorized access to fan controls and settings.
  9. The controller shall operate out of the box without setup and upon connection to CAT5 cable.
- K. BAFCon Controller
1. The fan shall have the option of operating with the BAFCon controller.
  2. The digital controller user interface shall be a wall-mounted touchscreen with a 5-inch (127-mm) display and an 800 (RGB) x 480 pixel resolution.
  3. The digital controller shall be mounted to a standard rectangular or square outlet box.
  4. A 150-ft (45.7-m) CAT5 cable shall be provided for connecting the digital controller to the fan's VFD, allowing for seamless communication between BAFCon and the VFD. The cable shall provide power to the digital controller.
  5. The digital controller shall not require a 120 V power supply at the controller mounting location.
  6. The digital controller mounting location shall meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.
  7. The digital controller shall support up to eight Powerfoil X3.0 or Powerfoil X3.0 Plus fans controlled as a group or individually.
  8. The digital controller shall provide fan start/stop, speed, and direction control functions.
  9. The digital controller shall provide diagnostic and fault history information for each connected fan as well as the ability to configure fan parameters with the assistance of Big Ass Fans Customer Service.
  10. The digital controller shall include optional SmartSense functionality to maximize energy savings. SmartSense shall provide the capability to automatically control the speed of Big Ass Fans using information from user-determined settings and built-in temperature and humidity sensors.
  11. The digital controller shall include a scheduling feature that shall provide the ability to create up to four fan schedules for turning fans on/off and turning Auto mode on/off. The scheduling feature shall require the date and time to be set on the controller.
  12. The digital controller interface shall be able to be secured with user and admin passcodes to prevent unauthorized access to fan controls and settings.
  13. The digital controller shall be BACnet-compatible.
  14. BAFCon Multi-Fan Accessory Kit
    - a. Multiple fans will be installed, the BAFCon Multi-Fan Accessory Kit shall be provided.

- b. The kit shall include a two-screw RJ45 terminal block, a ¼ Watt, 120 Ohm termination resistor, RJ45 pass through splitters, and split-gland cord grips for connecting multiple fans to the controller.
- L. Fire Control Panel Integration
  - 1. Includes a 10–30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.
- M. Guy Wires
  - 1. Included for installations with extension tubes 4 ft (1.2 m) or longer to limit the potential for lateral movement.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Fan location shall have a typical bar joist or existing I-beam structure from which to mount the fan. Additional mounting options may be available.
- B. Mounting structure shall be able to support weight and operational torque of fan. Consult structural engineer if necessary.
- C. Fan location shall be free from obstacles such as lights, cables, or other building components.
- D. Check fan location for proper electrical requirements. Consult installation guide for appropriate circuit requirements.
- E. Each fan requires dedicated branch circuit protection.
- F. Before the controller is installed, the fan system shall be installed by a factory-certified installer according to the instructions in the fan Installation Guide.
- G. Install a rectangular or square outlet box at the controller mounting location.
- H. If the optional BAFCon controller will be mounted more than 250 ft (76.2 m) from the fan or if multiple fans will be daisy chained, ensure the BAFCon Accessory Kit is included. The accessory kit shall be installed by a factory-certified installer according to the instructions included with the kit.

### 3.2 INSTALLATION

- A. The fan shall be installed by a factory-certified installer according to the manufacturer's Installation Guide, which includes acceptable structural dimensions and proper sizing and placement of angle irons for bar joist applications. Big Ass Fans recommends consulting a structural engineer for installation methods outside the manufacturer's recommendation and a certification, in the form of a stamped print or letter, submitted prior to installation.
- B. Minimum Distances
  - 1. Airfoils shall be at least 10 ft (3.05 m) above the floor.
  - 2. Installation area shall be free of obstructions such as lights, cables, sprinklers, or other building structures with the airfoils at least 2 ft (0.61 m) clear of all obstructions.
- C. The fan shall not be located where it will be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems or radiant heaters. Additional details are in the Big Ass Fans Installation Manual.
- D. In buildings equipped with sprinklers, including ESFR sprinklers, fan installation shall comply with all of the following:
  - 1. The maximum fan diameter shall be 24 ft (7.3 m).
  - 2. The HVLS fan shall be centered approximately between four adjacent sprinklers.
  - 3. The vertical clearance from the HVLS fan to the sprinkler deflector shall be a minimum of 3 ft (0.9 m).
  - 4. All HVLS fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72—National Fire Alarm and Signaling Code.
- E. Mount the controller to a flat, readily accessible surface that is free from vibration and away from foreign objects and moving equipment. The controller mounting location must meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.

- F. If the SmartSense feature will be used, the optional BAFCon controller must not be mounted adjacent to or above a radiant heat source, near HVAC ventilation intakes/exhausts, on a poorly insulated exterior wall, or in a different temperature/humidity environment than the fans it will control. Additional mounting guidelines can be found in the Installation Guide.

END OF SECTION

SECTION 233423

HVAC POWER VENTILATORS

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 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. Section Includes:
  - 1. Ceiling-mounted inline ventilators. (EF-1,2)

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: 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. Wiring Diagrams: For power, signal, and control wiring.
  - 3. 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.
- C. Operation and maintenance data.
- D. Steel Certifications.

## 1.5 QUALITY ASSURANCE

- 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

## PART 2 - PRODUCTS

### A. CEILING-MOUNTED INLINE VENTILATORS

- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Greenheck.
  - 2. Penn Ventilator.
  - 3. Loren Cook Company.
  - 4. Or approved equal.
- C. Type: Shall be duct mounted, and of the centrifugal direct driven type. The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
- D. Housing: One side of the housing shall be equipped with a hingeable service door assembly supporting the motor, drives, wheel and inlet cone. The door assembly must swing out for cleaning, inspection, or service without dismantling the fan in any way. and shall overlap and spun inlet venturi for maximum performance.
- E. Motor: The motor and drives shall be isolated from the air stream. Motors shall be of the heavy-duty type with permanently lubricated, sealed ball bearings. The wheel shaft shall be ground and polished shafting mounting in heavy duty permanently sealed pillow block bearings. Drives shall be sized for a minimum of 165% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. The motor pulleys shall be adjustable for final system balancing.
- F. Electrical Requirements Flexible wiring leads shall be provided from the fan motor to an external mounted junction box and disconnect switch permitting access for service without disconnecting the field wiring. All fans shall bear the AMCA Certified Ratings Seal for both air and sound performance.

## 2.2 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- B. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

### 3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 FIELD QUALITY CONTROL

- A. 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.
- B. Tests and Inspections:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.
  4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  5. Adjust belt tension.
  6. Adjust damper linkages for proper damper operation.
  7. Verify lubrication for bearings and other moving parts.
  8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  9. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

END OF SECTION



## SECTION 233710

### AIR INLETS AND OUTLETS

#### PART 1 GENERAL

##### 1.1 STIPULATIONS

- A. The General Conditions, drawings and all other attached documents form a part of this Section and all other Sections by reference thereto and have the same force and effect as if printed herewith in full. The Contractor shall be strictly accountable for the cognizance of carrying out the provisions thereof.

#### PART 2 PRODUCTS

##### 2.1 AIR CONTROL DEVICES

- A. This Contractor shall furnish and install air control devices and accessories, as shown on plans and as specified herein.
- B. Interior grilles, registers diffusers, and louvers shall have white enamel finish ready for field painting.
- C. All security air control devices shall be installed with vandal proof screws. Fasteners shall be one-way vandal proof #8 - 3/4 S/M screws. Through bolts shall be one-way vandal proof heads.
- D. Air control devices shall be as manufactured by Anemostat, Titus Corporation, Price or approved equal.
- E. Shop drawings showing room schedule, style, catalog numbers, finish, size, details, CFM, NC ratings, and accessories shall be submitted for review.
- F. For the purpose of setting a minimum standard, Model numbers listed below shall be referenced to Price or Anemostat, unless otherwise noted. Other manufacturers submitted shall be in all ways equal with NC ratings limited to a maximum of NC 30, as accepted by the Professional.

##### 1. Ceiling Diffusers (CD)

##### a. Square Ceiling Diffusers:

- (1). Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- (a). Tuttle & Bailey.
- (b). Carnes.
- (c). Hart & Cooley Inc.
- (d). METALAIRE, Inc.

- (2). Devices shall be specifically designed for variable-air-volume flows.
- (3). Material: Aluminum.
- (4). Finish: Baked enamel, white
- (5). Face Style: Three cone.

- (6). Mounting: Lay-In, Surface Mounted and Duct-Mounted (See Drawings).
- (7). Pattern: Fixed

#### 1. Ceiling Mounted Return Grille (RG)

- a. Panels shall be steel with square/rectangular necks. ½" x ½" x ½" deep egg crate face return with mounting frame to match ceiling type.
- b. Panel face shall be finished in white finish shade as selected by the Professional to match the ceiling tile.
- c. The unit shall be similar to Price 80.

### 2.2 LOUVERS

- A. All louvers performance shall equal or surpass the minimum free area, maximum static pressure, and airflow requirements for the specified application.
- B. 4" Louvers.
  - 1. Furnish and install where indicated on drawings for air handling units and other intakes or exhausts 4" deep thick louvers with 1/4" x 1/4" aluminum bird screen.
  - 2. Frames and blades shall be 6063-T5 alloy, extruded aluminum sections of a minimum 12 gauge (0.081 inch) thickness with 2 reinforcing bosses, heads, sills, jambs to be one piece structural members. Maximum blade span shall be 96 inches; greater spans shall employ a rigid vertical mullion.
  - 3. Louvers shall be Model XB-4 as manufactured by Airline Products Co., Airstream Model SA, Ruskin Model ELF 375, or Arrow United Industries, Inc., Model SPA-11. Louvers shall be color as selected by the Professional.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Coordinate all devices with ceiling grid, construction and type, and work of other trades.
- B. See also "ACCESS PANELS".
- C. Spin Collars: For each flexible duct connection off of a main or branch duct to a ceiling diffuser and for each outlet off of the ventilation ductwork to the plenum air furnish and install a spin collar with a positive locking balancing damper.
- D. Backdraft Dampers
  - 1. Furnish and install for all gravity relief louvers and ventilators, back-draft design.
  - 2. Where multiple sections are required, this Contractor shall provide additional mullions and bearings to support total assembly. Seal all joints weathertight.

END OF SECTION

## SECTION 235400 - FURNACES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Gas-fired, condensing furnaces and accessories complete with controls.
  - 2. Air filters.
  - 3. Air cleaners.
  - 4. Ultraviolet germicidal lights.
  - 5. Refrigeration components.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each of the following:
  - 1. Furnace.
  - 2. Thermostat.
  - 3. Air filter.
  - 4. Ultraviolet germicidal light.
  - 5. Refrigeration components.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Special warranty specified in this Section.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each furnace to include in emergency, operation, and maintenance manuals for each of the following:

1. Furnace and accessories complete with controls.
2. Air filter.
3. Ultraviolet germicidal light.
4. Refrigeration components.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Disposable Air Filters: Furnish two complete sets.
  2. Fan Belts: Furnish one set for each furnace fan.

#### 1.7 QUALITY ASSURANCE

- A. 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.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. Comply with NFPA 70.

#### 1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of furnaces that fail in materials or workmanship within specified warranty period:
  1. Warranty Period, Commencing on Date of Substantial Completion:
    - a. Furnace Heat Exchanger: 10 years.
    - b. Integrated Ignition and Blower Control Circuit Board: Five years.
    - c. Draft-Inducer Motor: Five years.
    - d. Refrigeration Compressors: 10 years.
    - e. Evaporator and Condenser Coils: Five years.

## PART 2 - PRODUCTS

### 2.1 GAS-FIRED FURNACES, CONDENSING

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
  - 1. Carrier Corporation; Div. of United Technologies Corp.
  - 2. Trane.
  - 3. York International Corp.; a division of Unitary Products Group.
- D. General Requirements for Gas-Fired, Condensing Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21.47/CSA 2.3, "Gas-Fired Central Furnaces," and with NFPA 54.
- E. Cabinet: Steel.
  - 1. Cabinet interior around heat exchanger shall be factory-installed insulation.
  - 2. Lift-out panels shall expose burners and all other items requiring access for maintenance.
  - 3. Factory paint external cabinets in manufacturer's standard color.
  - 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- F. Fan: Centrifugal, factory balanced, resilient mounted, direct drive.
  - 1. Fan Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 2. Special Motor Features: Single speed, Premium (TM) efficiency, as defined in Section 230513 "Common Motor Requirements for HVAC Equipment," and with internal thermal protection and permanent lubrication.
  - 3. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
  - 4. Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.
- G. Type of Gas: [Natural] [Propane].
- H. Heat Exchanger:
  - 1. Primary: Stainless steel.
  - 2. Secondary: Stainless steel.
- I. Burner:

1. Gas Valve: 100 percent safety modulating main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
  2. Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.
- J. Gas-Burner Safety Controls:
1. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven; stops gas flow on ignition failure.
  2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
  3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.
- K. Combustion-Air Inducer: Centrifugal fan with thermally protected motor and sleeve bearings prepurges heat exchanger and vents combustion products; pressure switch prevents furnace operation if combustion-air inlet or flue outlet is blocked.
- L. Furnace Controls: Solid-state board integrates ignition, heat, cooling, and fan speeds; adjustable fan-on and fan-off timing; terminals for connection to accessories diagnostic light with viewport.
- M. Accessories:
1. Combination Combustion-Air Intake and Vent: PVC plastic fitting to combine combustion-air inlet and vent through outside wall.
  2. CPVC Plastic Vent Materials.
    - a. CPVC Plastic Pipe: Schedule 40, complying with ASTM F 441/F 441M.
    - b. CPVC Plastic Fittings: Schedule 40, complying with ASTM F 438, socket type.
    - c. CPVC Solvent Cement: ASTM F 493.
      - 1) CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      - 2) Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      - 3) Solvent cement and adhesive primer 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."
  3. PVC Plastic Vent Materials:
    - a. PVC Plastic Pipe: Schedule 40, complying with ASTM D 1785.
    - b. PVC Plastic Fittings: Schedule 40, complying with ASTM D 2466, socket type.
    - c. PVC Solvent Cement: ASTM D 2564.
      - 1) PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      - 2) Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- 3) Solvent cement and adhesive primer 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."

## 2.2 THERMOSTATS

- A. Controls shall comply with requirements in ASHRAE/IESNA 90.1, "Controls."
- B. Solid-State Thermostat: Wall-mounting programmable, microprocessor-based unit with automatic switching from heating to cooling, preferential rate control, seven-day programmability with minimum of four temperature presets per day, and battery backup protection against power failure for program settings.
- C. Two-Stage, Heating-Cooling Thermostat: Adjustable, heating-cooling, wall-mounting unit with fan on-automatic selector.
- D. Control Wiring: Unshielded twisted-pair cabling.
  1. No. 24 AWG, 100 ohm, four pair.
  2. Cable Jacket Color: Blue.

## 2.3 AIR FILTERS

- A. Disposable Filters: 1-inch-thick fiberglass media with ASHRAE 52.2 MERV rating of 6 or higher, in sheet metal frame.

## 2.4 ULTRAVIOLET GERMICIDAL LIGHTS

- A. Description: Lighting unit in metal housing arranged for installation in supply-air duct and controlled to cycle on and off with furnace fan, with one 75-W ultraviolet-light bulb(s).

## 2.5 REFRIGERATION COMPONENTS

- A. General Refrigeration Component Requirements:
  1. Refrigeration compressor, coils, and specialties shall be designed to operate with CFC-free refrigerants.
  2. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings."
- B. Refrigerant Coil: Copper tubes mechanically expanded into aluminum fins. Comply with ARI 210/240, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment." Match size with furnace. Include condensate drain pan with accessible drain outlet complying with ASHRAE 62.1.

1. Refrigerant Coil Enclosure: Steel, matching furnace and evaporator coil, with access panel and flanges for integral mounting at or on furnace cabinet and galvanized sheet metal drain pan coated with black asphaltic base paint.
- C. Refrigerant Line Kits: Annealed-copper suction and liquid lines factory cleaned, dried, pressurized with nitrogen, sealed, and with suction line insulated. Provide in standard lengths for installation without joints, except at equipment connections.
1. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I, 1 inch thick.
- D. Refrigerant Piping: Comply with requirements in Section 232300 "Refrigerant Piping."
- E. Air-Cooled, Compressor-Condenser Unit:
1. Casing: Steel, finished with baked enamel, 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.
  2. Compressor: Hermetically sealed reciprocating type.
    - a. Crankcase heater.
    - b. Vibration isolation mounts for compressor.
    - c. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
    - d. Variable-speed compressor motors shall have manual-reset high-pressure switch and automatic-reset low-pressure switch.
    - e. Refrigerant: R-407C or R-410A.
  3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
  4. Heat-Pump Components: Reversing valve and low-temperature air cut-off thermostat.
  5. Fan: Aluminum-propeller type, directly connected to motor.
  6. Motor: Permanently lubricated, with integral thermal-overload protection.
  7. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
  8. Mounting Base: Polyethylene.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine factory-installed insulation before furnace installation. Reject units that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for gas and refrigerant piping systems to verify actual locations of piping connections before equipment installation.



- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install gas-fired furnaces and associated fuel and vent features and systems according to NFPA 54.
- B. Install oil-fired furnaces and associated fuel and vent piping according to NFPA 31.
- C. Suspended Units: Suspend from structure using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
  - 1. Install seismic restraints to limit movement of furnace by resisting code-required seismic acceleration.
- D. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.
  - 1. Anchor furnace to substrate to resist code-required seismic acceleration.
- E. Controls: Install thermostats and humidistats at mounting height of 60 inches above floor.
- F. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.
- G. Install ground-mounted, compressor-condenser components on 6-inch-thick, reinforced concrete base; as indicated on the drawings.

### 3.3 CONNECTIONS

- A. Gas piping installation requirements are specified in Section 231126 "Facility Liquefied-Petroleum Gas Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Vent and Outside-Air Connection, Condensing, Gas-Fired Furnaces: Connect plastic piping vent material to furnace connections and extend outdoors. Terminate vent outdoors with a cap and in an arrangement that will protect against entry of birds, insects, and dirt.
  - 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. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
    - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
    - b. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

- c. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
- d. Requirements for Low-Emitting Materials:
  - 1) CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2) PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 3) Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 4) Solvent cement and adhesive primer 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."
- 4. Slope pipe vent back to furnace or to outside terminal.
- D. Connect ducts to furnace with flexible connector. Comply with requirements in Section 233300 "Air Duct Accessories."
- E. Connect refrigerant tubing kits to refrigerant coil in furnace and to air-cooled, compressor-condenser unit.
  - 1. Flared Joints: Use ASME B16.26 fitting and flared ends, following procedures in CDA's "Copper Tube Handbook."
  - 2. 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.
  - 3. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Comply with requirements in Section 232300 "Refrigerant Piping" for installation and joint construction of refrigerant piping.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform electrical test and visual and mechanical inspection.
  - 2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
  - 4. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
  - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

### 3.5 STARTUP SERVICE

- A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
  - 1. Inspect for physical damage to unit casings.
  - 2. Verify that access doors move freely and are weathertight.
  - 3. Clean units and inspect for construction debris.
  - 4. Verify that all bolts and screws are tight.
  - 5. Adjust vibration isolation and flexible connections.
  - 6. Verify that controls are connected and operational.
- B. Adjust fan belts to proper alignment and tension.
- C. Start unit according to manufacturer's written instructions and complete manufacturer's operational checklist.
- D. Measure and record airflows.
- E. Verify proper operation of capacity control device.
- F. After startup and performance test, lubricate bearings and adjust belt tension.

### 3.6 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set controls, burner, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

### 3.7 CLEANING

- A. After completing installation, clean furnaces internally according to manufacturer's written instructions.
- B. Install new filters in each furnace within 14 days after Substantial Completion.

### 3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain condensing units. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 235400

## SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: 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. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

## 1.6 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. Filters: One set for each air-handling unit.
  - 2. Gaskets: One set for each access door.

## 1.7 QUALITY ASSURANCE

- 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. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

## 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 that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five years from date of Substantial Completion.
    - b. For Parts: One year from date of Substantial Completion.
    - c. For Labor: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
  2. Lennox International Inc.
  3. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
  4. Mitsubishi Electric Sales Canada Inc.
  5. Mitsubishi Heavy Industries America, Inc.
  6. SANYO North America Corporation; SANYO Fisher Company.
  7. Trane; a business of American Standard companies.
  8. YORK; a Johnson Controls company.

### 2.2 INDOOR UNITS (5 TONS (18 kW) OR LESS)

- A. Wall-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
  2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  3. Fan: Direct drive, centrifugal.
  4. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements.
    - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    - c. Enclosure Type: Totally enclosed, fan cooled.
    - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
    - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
    - f. Mount unit-mounted disconnect switches on interior of unit.
  5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  6. Condensate Drain Pans:
    - a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
      - 2) Depth: A minimum of 1 inch (25 mm) deep.

- b. Single-wall, galvanized-steel sheet.
  - c. Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
  - d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
    - 1) Minimum Connection Size: NPS 1 (DN 25).
  - e. Pan-Top Surface Coating: Asphaltic waterproofing compound.
7. Air Filtration Section:
- a. General Requirements for Air Filtration Section:
    - 1) Comply with NFPA 90A.
    - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
    - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
  - b. Disposable Panel Filters:
    - 1) Factory-fabricated, viscous-coated, flat-panel type.
    - 2) Thickness: 1 inch (25 mm).
    - 3) Arrestance according to ASHRAE 52.1: 80.
    - 4) Merv according to ASHRAE 52.2: 5.
    - 5) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
    - 6) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

## 2.3 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

### A. Air-Cooled, Compressor-Condenser Components:

- 1. Casing: Steel, finished with baked enamel in color selected by Architect, 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.
- 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - a. Compressor Type: Scroll.
  - b. Modulating compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
  - c. Refrigerant Charge: R-410A.

- d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.
5. Mounting Base: Polyethylene.

## 2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan. Thermostat shall display both temperature and humidity.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Drain Hose: For condensate.

## 2.5 CAPACITIES AND CHARACTERISTICS

- A. Cooling Capacity:
  1. As shown on plans.
- B. Indoor Unit:
  1. Fan Motor Electrical Characteristics:
    - a. Volts: 208, fed from outdoor unit.
    - b. Phase: Single.
    - c. Hertz: 60.
  2. Airflow: 523 cfm.
- C. Outdoor Unit:
  1. Type: Air cooled.
  2. Electrical Characteristics:
    - a. Volts: 208, feed-thru type.
    - b. Phase: Single.
    - c. Hertz: 60.
    - d. Minimum Circuit Ampacity: 20A.
    - e. Maximum Overcurrent Protection: 30A.
    - f. Fan Motor Full-Load Amperes: 0.5.
    - g. Compressor Full-Load Amperes: 7.0.
    - h. Compressor Locked-Rotor Amperes: 17.5.



3. Sound-Pressure Level: 51 dBa.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Equipment Mounting:
  1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
  3. Provide manufacturer's standard vibration isolation devices.
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### 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. 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.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

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.
- B. The specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.3 SUMMARY**

- A. Section Includes:
  - 1. Electrical equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Grout.
  - 5. Common electrical installation requirements.

#### **1.4 DEFINITIONS**

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### **1.5 SUBMITTALS**

- A. Product Data: For sleeve seals.

#### **1.6 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 sleeve selection and application with selection and application of firestopping.

## 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.

### 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  3. Pressure Plates: Carbon steel. Include two for each sealing element.
  4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 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. 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.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 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. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- C. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- D. 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.

### 3.3 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.

**END OF SECTION 260500**

## **SECTION 260510 - ELECTRICAL EQUIPMENT WIRING**

### **PART 1 - GENERAL**

#### **1.1 STIPULATIONS**

- A. The specifications sections “General Conditions of the Construction Contract”, and “Special Conditions” 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 specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### **1.2 SECTION INCLUDES**

- A. Mechanical Equipment wiring, and General Equipment wiring.

### **PART 2 - PRODUCTS**

#### **2.1 PRODUCTS**

- A. Products are specified within Divisions 26, 27, and 28 Sections.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. The General, HVAC and Plumbing Contractors shall furnish all motors, starters, pushbuttons for local and remote control, controllers, pressure switches, aquastats or similar items together with all appurtenances, accessories and control wiring required to operate the equipment furnished under their respective sections of the contract, which is necessary to perform the operating functions as specified, shown on the drawings, or as otherwise required.
- B. The General, HVAC and Plumbing Contractors shall set and mount all motors, starters and controls. This Contractor shall furnish and install all safety switches at the equipment and make all power connections to the safety switches, starters, and the motors. All control wiring necessary for the required performance and operation of the equipment shall be installed and connected under each respective and associated contract. Where the starter and/or safety switch is an integral part of the equipment assembly, the assembly shall be furnished with the wiring being complete between the starter, controller and motor and this Contractor shall make the power connections only at the unit.

- C. If procurement requirements necessitate a change in the electrical characteristics of any motor or equipment being furnished under the General, HVAC or Plumbing Contract, the respective Contractor shall first obtain approval of such changes from the Department. The same Contractor shall also be responsible for all necessary arrangement and shall pay all costs, if any, for all required changes to this contract.

### 3.2 GENERAL REQUIREMENTS

- A. This Contractor shall furnish, install, and connect all power wiring to all equipment and all associated controls and appurtenances provided under this section of the contract. In addition, this Contractor shall furnish, install and connect all power wiring to all equipment, associated controls and appurtenances provided under other sections of this contract, unless otherwise specified herein or indicated on the drawings. All necessary and required control wiring for the aforementioned equipment and systems shall be furnished, installed and connected by the respective Contractors providing the equipment, unless otherwise specified herein or indicated on the drawings.

### 3.3 WIRING FOR HEATING, VENTILATING AND AIR CONDITIONING

- A. All equipment for the heating, ventilating and air conditioning systems shall be furnished and installed under the HVAC Contract, unless otherwise indicated.
- B. This Contractor shall be responsible for furnishing all labor and materials required for the installation and connection of all electrical power wiring to and for the HVAC equipment, unless otherwise indicated.
- C. In general, all starters and special control equipment required for the heating, ventilating and air conditioning equipment such as the unit heaters, air handling units, etc., will be furnished and installed under the temperature control section of the HVAC Contract, unless otherwise indicated.

### 3.4 TEMPERATURE CONTROL WIRING

- A. All interconnecting control wiring associated with the temperature control system(s) for heating and air conditioning system(s) shall be furnished, installed and connected under the HVAC Contract.
- B. This Contractor shall provide a source of power and make final power connections for all temperature control system equipment (air handling units, etc.) and at each apparatus control panel location. Temperature Control Panels shall be furnished and installed under the HVAC Contract.

### 3.5 ELECTRICAL WORK FOR ROOF VENTILATORS AND/OR EXHAUST FANS

- A. For single-phase units, a motor starting disconnecting type snap switch shall be furnished as an integral part of the roof ventilator or exhaust fan. However, this Contractor shall furnish a

remote-control thermal overload switch with pilot light. Switch shall be installed within the room to be ventilated or exhausted, as indicated on the drawings but generally adjacent to unit.

- B. For 3-phase units, this Contractor shall furnish and install remote control switches, together with pilot lights, within the room to be ventilated or exhausted at location as indicated on the drawings. In addition, the Contractor shall furnish and install a disconnect switch (in proper NEMA rated enclosure) at motor location.

### 3.6 WIRING FOR PLUMBING EQUIPMENT

- A. All equipment for the plumbing system shall be furnished and installed under the Plumbing Contract, unless otherwise indicated.
- B. This Contractor shall be responsible for furnishing all labor and materials required for the installation and connection of all electrical power wiring to and for the Plumbing equipment, unless otherwise indicated.
- C. In general, all starters and special control equipment required for electrically operated equipment furnished under the Plumbing Contract, such as the pumps and electric water heaters will be furnished and installed by the Plumbing Contractor.

### 3.7 ELECTRICAL EQUIPMENT BY OTHERS

- A. All electrical equipment furnished and installed under contracts other than this contract shall be furnished with full complement of control equipment, control wiring, conduit, and all other items necessary for satisfactory operation.
- B. Remote motor starters for equipment furnished under contracts other than this contract shall be furnished and installed by the respective Contractor providing the equipment.
- C. This Contractor shall furnish and install fused disconnect switches, to include properly rated and type of fuses, for all 3-phase equipment unless otherwise indicated.
- D. This Contractor shall furnish and install thermal overload switches for each single-phase motor except where units are furnished with built-in thermal protection, in which case this Contractor shall furnish and install a single pole switch, with or without pilot light as indicated on the drawings or directed by the Department.
- E. This Contractor shall complete all power wiring through the disconnect switch and/or thermal cutouts and local control stations to the equipment as required.
- F. This Contractor shall complete all electrical connections, through the disconnect switch, starter and motor terminals of all 3-phase equipment. This Contractor shall be responsible for final connections.
- G. This Contractor shall be responsible for proper direction of rotation of 3-phase motors.
- H. This Contractor shall provide disconnect switches for all 3-phase equipment. Combination motor starter/disconnect switches shall be furnished and installed under the contracts providing



the equipment. This Contractor shall provide disconnect switches at motor when motors are located away from combination starter/disconnect switches.

### 3.8 LOCATIONS

- A. This Contractor 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 this Contractor's failure to obtain this information shall be relocated and reinstalled without additional expense to the Department.
- B. The design shall be subject to such revisions as may be necessary to overcome building obstructions. No changes shall be made in location of outlets or equipment without written consent of the Department.
- C. This Contractor is cautioned that all outlet information must be checked and verified before installation; and all stub-ups into equipment must be as indicated and detailed on the respective shop drawings.
- D. Unless otherwise detailed on the drawings, rough-in of proper size and capacity of mechanical equipment indicated on the drawings as "Future" or "N.I.C." shall be provided and installed in such a manner and location that future final connections can be made with a minimum of work and without cutting or patching permanent walls, partitions, ceiling or floors.
- E. Engineering drawings are, of necessity, schematics for special equipment as exact roughing-in and requirements may vary with different manufacturers. Each trade shall connect its respective services to all special equipment indicated on the drawings at no additional cost to the Department.

**END OF SECTION 260510**

## **SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

### **PART 1 - GENERAL**

#### **1.1 STIPULATIONS**

- A. The specifications sections “General Conditions of the Construction Contract”, and “Special Conditions” 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 specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.3 SUMMARY**

- A. This Section includes the following:
  - 1. Building wires rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

#### **1.4 DEFINITIONS**

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### **1.5 SUBMITTALS**

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

#### **1.6 QUALITY ASSURANCE**

- A. 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.
- B. Comply with NFPA 70.

#### **1.7 COORDINATION**

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

## PART 2 - PRODUCTS

### PART 3 - CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. American Insulated Wire Corp.; a Leviton Company.
  - 3. General Cable Corporation.
  - 4. Senator Wire & Cable Company.
  - 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

### 3.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Hubbell Power Systems, Inc.
  - 3. O-Z/Gedney; EGS Electrical Group LLC.
  - 4. 3M; Electrical Products Division.
  - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 4 - EXECUTION

### 4.1 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.

### 4.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- J. Class 2 Control Circuits: Type THHN-THWN, in raceway.

#### 4.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls and ceilings unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

#### 4.4 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.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

#### 4.5 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

#### 4.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Retain first paragraph and subparagraphs below to describe tests and inspections to be performed by either of the entities in two paragraphs above.
- C. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
    - a. Panel board Feeders.
    - b. Branch-circuit conductors
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

**END OF SECTION 260519**

## **SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL 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.
- B. The specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.3 SUMMARY**

- A. This Section includes methods and materials for grounding systems and equipment.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
  - 1. Test wells.
  - 2. Ground rods.
- C. Field quality-control test reports.

#### **1.5 QUALITY ASSURANCE**

- A. 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.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### **PART 2 - PRODUCTS**

#### **2.1 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. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches (6 by 50 mm) in cross section, unless otherwise indicated; with insulators. Minimum 12" long, predrilled and/or punched.

## 2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 5/8 inch by 8 feet.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum.
  - 1. Bury at least 30 inches below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
  - 3. Tracer (independent of trench tape): #12 THHN CU buried 12" below finished rough grade along trench for tracing capabilities.
- B. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) 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, down to specified height above floor, and connect to horizontal bus.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Pad-Mounted Transformers: Install four ground rods (one at each corner) and ground ring around the vault. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes.

### 3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. 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.
- C. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor (or as otherwise directed) in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus with standoff insulators.
  2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- D. Specialized gas piping: ground all gas piping as per NEC and manufacturer's recommendations.

### 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. Ground Rods: Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
  1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.



2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor (or as otherwise directed).
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole and shall be at least 12 inches (300 mm) deep, with cover.
1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. 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 so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, 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.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. 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 (18 m) apart. Provide 4/0 AWG copper from in-slab rebar to each column as per NEC.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

- b. Perform tests by fall-of-potential method according to IEEE 81.
  - 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed the following values:
- 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
  - 2. Pad-Mounted Equipment: 5 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
- D. Provide a complete, detailed grounding report with all measured ground resistances.

**END OF SECTION 260526**

## **SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 STIPULATIONS**

- A. The specifications sections “General Conditions of the Construction Contract” and “Special Conditions” 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 specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

#### **1.3 SUMMARY**

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

#### **1.4 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

#### **1.5 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Steel slotted support systems.

#### **1.6 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

#### **1.7 COORDINATION**

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. Thomas & Betts Corporation.
    - e. Unistrut; Tyco International, Ltd.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. 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 in which used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Hilti Inc.
      - 3) MKT Fastening, LLC.
    - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
    - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
    - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
    - 5. Hanger Rods: Threaded steel.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted 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 single-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) 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, as permitted in 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 (90 kg).
- 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 New Concrete: Bolt to concrete inserts.
  - 2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 3. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  - 4. To Light Steel: Sheet metal screws.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 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 (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 painting Sections 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 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 STIPULATIONS**

- A. The specifications sections “General Conditions of the Construction Contract” and “Special Conditions” 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 specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

#### **1.3 SUMMARY**

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

#### **1.4 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.

#### **1.5 SUBMITTALS**

- A. Product Data: For raceways, surface raceways, wire-ways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

#### **1.6 QUALITY ASSURANCE**

- A. 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.

- B. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 3. O-Z Gedney; a unit of General Signal.
  - 4. Wheatland Tube Company.
- B. EMT: ANSI C80.3.
- C. FMC: Zinc-coated steel.
- D. LFMC: Flexible steel conduit with PVC jacket.
- E. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Fittings for EMT: compression type.

### 2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Lamson & Sessions; Carlon Electrical Products.
  - 3. RACO; a Hubbell Company.
  - 4. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- C. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
  - 1. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
  - 2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 3. Underground Conduit (rising): Shall have long sweep RGS elbows and continue RGS to terminations.
  - 4. Service Entrance: Shall be RGS where exposed.



- B. Comply with the following indoor applications, unless otherwise indicated:
  - 1. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 2. Branch circuits concealed in walls and above ceilings: EMT
  - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) 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.

### 3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls and above ceilings, unless otherwise indicated.
- H. No conduit shall be run in floor slab except for service entrance conduit and communications entrance conduit, unless noted otherwise.
- I. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Change from ENT to IMC before rising above the floor.
- J. 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.
- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations 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 at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where conduit pass from an unclassified space to a classified space.
3. Where otherwise required by NFPA 70 (NEC 2005).

N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
  - a. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

O. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for 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 in damp or wet locations not subject to severe physical damage.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter. Performed by General Contractor.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving." Performed by Electrical Contractor.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose.
  - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.4 FIRESTOPPING

- A. Apply fire-stopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.5 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION 260533**

## **SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 STIPULATIONS**

- A. The specifications sections “General Conditions of the Construction Contract” and “Special Conditions” 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 specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

#### **1.3 SUMMARY**

- A. Section Includes:
  - 1. Identification for raceways.
  - 2. Identification for conductors.
  - 3. Underground-line warning tape.
  - 4. Equipment identification labels.
  - 5. Miscellaneous identification products.

#### **1.4 SUBMITTALS**

- A. Product Data: For each electrical identification product indicated.

#### **1.5 QUALITY ASSURANCE**

- A. Comply with ANSI 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. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

#### **1.6 COORDINATION**

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

### 2.2 CONDUCTOR IDENTIFICATION MATERIALS

- A. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

### 2.3 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 2. Inscriptions for Red-Colored Tapes: **ELECTRIC LINE, HIGH VOLTAGE.**
  - 3. Inscriptions for Orange-Colored Tapes: **COMMUNICATIONS CABLE.**
- C. Tag: Type ID:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils (0.125 mm).
3. Foil Core Thickness: 0.35 mil (0.00889 mm).
4. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
5. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

## 2.4 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

## 2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
- F. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

## 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  1. Normal Emergency.
  2. Standby.
  3. Telecom.

- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
    - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
    - c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- D. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- E. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
    - a. Indoor Equipment: Self-adhesive, engraved, melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
    - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - d. Enclosed switches.
    - e. Enclosed controllers.
    - f. Receptacles (circuit number)

g. Switches (circuit number)

**END OF SECTION 260553**



## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 STIPULATIONS

- A. The specifications sections “General Conditions of the Construction Contract” and “Special Conditions” 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 specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

#### 1.3 SUMMARY

- A. This Section includes the following lighting control devices:
  - 1. Time switches.
  - 2. Outdoor Photoelectric Switches

#### 1.4 SUBMITTALS

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

#### 1.5 QUALITY ASSURANCE

- A. 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.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

### PART 2 - PRODUCTS

#### 2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Intermatic, Inc.
  2. Leviton Mfg. Company Inc.
  3. Paragon Electric Co.; Invensys Climate Controls.
  4. Square D; Schneider Electric.
  5. TORK.
- B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
1. Contact Configuration: SPST.
  2. Contact Rating: 20-A ballast load, 277-V ac.
  3. Programs: 2 channels; each channel shall be individually programmable with 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
  4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
  5. Astronomic Time: All channels.
  6. Battery Backup: For schedules and time clock.

## 2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Area Lighting Research, Inc.; Tyco Electronics.
  2. Grasslin Controls Corporation; a GE Industrial Systems Company.
  3. Intermatic, Inc.
  4. Lithonia Lighting; Acuity Lighting Group, Inc.
  5. Novitas, Inc.
  6. Paragon Electric Co.; Invensys Climate Controls.
  7. Square D; Schneider Electric.
  8. TORK.
  9. Touch-Plate, Inc.
  10. Watt Stopper (The).
- B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
  2. Time Delay: 15-second minimum, to prevent false operation.
  3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
  4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
- C. Description: Solid state, with SPST dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.
1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
  2. Time Delay: 30-second minimum, to prevent false operation.
  3. Lightning Arrester: Air-gap type.
  4. Mounting: Twist lock complying with IEEE C136.10, with base.

## PART 3 - EXECUTION

### 3.1 WIRING INSTALLATION

- A. Wiring Method: Minimum conduit size shall be 3/4 inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.2 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

**END OF SECTION 260923**

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 STIPULATIONS

- A. The specifications sections “General Conditions of the Construction Contract” and “Special Conditions” 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 specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

#### 1.3 SUMMARY

- A. Section Includes:
  - 1. Distribution panel boards.
  - 2. Lighting and appliance branch-circuit panel boards.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "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.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- 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.

#### 1.6 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 NEMA PB 1.

#### 1.7 PROJECT 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 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
  - b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

#### 1.8 COORDINATION

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. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

#### 1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices 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 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Surface-mounted and flush-mounted cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  - 3. 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.
  - 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
  - 1. Material: Tin-plated aluminum.
  - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Tin-plated aluminum.
  - 2. Main and Neutral Lugs: Mechanical type.
  - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square-D
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

- C. Main Overcurrent Protective Devices: Circuit breaker, unless noted otherwise on panelboard schedule, electronic trip, fully adjustable. All settings shall be coordinated with the short circuit/coordination study prior to shop drawing submittal. Submit panelboard and short circuit/coordination study at the same time.
- D. Branch Overcurrent Protective Devices:
  - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
  - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

### 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square-D
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- H. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.4 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION 262416**



## SECTION 262713 - ELECTRICITY METERING

### 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.
- B. The specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.3 SUMMARY

- A. Section includes equipment for electricity metering by utility company and electricity metering requested by Owner.

#### 1.4 DEFINITIONS

- A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.
- B. PC: Personal computer.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For electricity-metering equipment.
  - 1. Dimensioned plans and sections or elevation layouts.
  - 2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.
- C. Operation and Maintenance Data. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Application and operating software documentation.
  - 2. Software licenses.
  - 3. Software service agreement.

4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

## 1.6 QUALITY ASSURANCE

- 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.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center according to NECA 400.

## 1.8 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
  1. Comply with requirements of utilities providing electrical power services.
  2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

## 1.9 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade his computer equipment if necessary.
  2. All licenses shall be at no additional cost to the owner and shall be open ended and unrestricted use.
  3. Any and all passwords must be coordinated with DMVA prior to establishing such.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT FOR ELECTRICITY METERING REQUESTED BY OWNER

- A. Manufacturers: Provide one of the following:
  1. Square D Power Logic Model 5560 (no substitutions).
- B. General Requirements for Owner's Meters:
  1. Comply with UL 1244.
  2. Meters used for data collection shall have an accuracy of 0.2 percent of reading, complying with requirements in ANSI C12.20.

3. Enclosure: NEMA 250, Type 1 minimum., manufacturer's recommended enclosure with clear panel for readings without opening doors. Provide with hasp for padlocking or sealing.
  4. Identification: Comply with requirements in Division 26 Section "Identification for Electrical Systems."
  5. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
  6. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
    - a. Type: Split core.
  7. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.
  8. Building Automation System (BAS) Interface: One digital KY pulse to a user-definable increment of energy measurement. Match signal to BAS input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.
  9. The system must report data to the Johnson Metasys head end at FTIG, Bldg 11-64. Provide all software and hardware for proper data transmission. Coordinate points and data prior to shop drawing submittal.
- C. Kilowatt-hour/Demand Meter: Electronic three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.
1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
  2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand, and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.
- D. Software: Preloaded by manufacturer. Loaded by means of cable into meter and is a product of meter manufacturer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters as per this specification. Provide any and all software, programming, and troubleshooting necessary for proper operation. Install raceways and equipment according to utility company's written requirements. Provide conduits for metering leads and extend grounding connections as required by utility company.

### 3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  1. Equipment Identification Labels: See "Identification for Electrical Systems".

**END OF SECTION 262713**

## **SECTION 262726 – WIRING DEVICES**

### **PART 1 - GENERAL**

#### **1.1 STIPULATIONS**

- A. The specifications sections “General Conditions of the Construction Contract” and “Special Conditions” 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 specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

#### **1.3 SUMMARY**

- A. This Section includes the following:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Snap switches.
  - 3. Cord and plug sets.

#### **1.4 DEFINITIONS**

- A. GFCI: Ground-fault circuit interrupter.
- B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

#### **1.5 SUBMITTALS**

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

#### **1.6 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- 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. Comply with NFPA 70.

## 1.7 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements and intended classification.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

### 2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 5351 (single), 5352 (duplex).
    - b. Hubbell; HBL5351 (single), CR5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5381 (single), 5352 (duplex).

### 2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; GF20.
    - b. Pass & Seymour; 2084.

### 2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.5 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
    - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

## 2.6 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Polycarbonate.
  3. Material for Unfinished Spaces: Galvanized steel.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, thermoplastic with lockable cover, rated weather-proof while in use.

## 2.7 FINISHES

- A. Color: Gray.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  1. Take steps to ensure devices and their boxes are protected. 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 the 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 just 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. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they 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 (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the 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. 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. All wall boxes shall be 4"x4" square with appropriate covers for type of installation (drywall, surface, etc.) This shall include receptacles, switches, and the like. Double duplex shall be multigang as necessary for proper installation.

### 3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles and switches (to include wall box occ sensors, etc.): Identify panelboard and circuit number from which served. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.



**END OF SECTION 262726**

## SECTION 262813 - FUSES

### 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.
- B. The specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.3 SUMMARY

- A. Section Includes:
  - 1. Cartridge fuses rated 600-V ac and less for use in enclosed switches and enclosed controllers.

#### 1.4 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.

#### 1.5 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.
- E. Comply with UL 248-11 for plug fuses.

#### 1.6 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C) , apply manufacturer's ambient temperature adjustment factors to fuse ratings.

#### 1.7 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels. Coordinate with coordination study recommended settings.

### 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.

### 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. Motor Branch Circuits: Class RK5, time delay.

### 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuse holders and sockets. Ensure that adapters are irremovable once installed.

### 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 specifications sections “General Conditions of the Construction Contract” and “Special Conditions” 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 specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

#### **1.3 SUMMARY**

- A. Section Includes:
  - 1. Fusible and non-fusible switches.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include 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 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.

#### **1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from a single source, from a 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 a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

## 1.6 PROJECT 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 (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
  - 2. Altitude: Not exceeding 6600 feet (2010 m).

## 1.7 COORDINATION

- 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.

## PART 2 - PRODUCTS

### 2.1 FUSIBLE AND NON-FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses as required, 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. Lugs: Mechanical type, suitable for number, size, and conductor material.

## 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.

### 3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Install fuses in fusible devices as required.
- C. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "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.

### 3.4 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

**END OF SECTION 262816**

## **SECTION 265100 - INTERIOR LIGHTING**

### **PART 1 - GENERAL**

#### **1.1 STIPULATIONS**

- A. The specifications sections “General Conditions of the Construction Contract” and “Special Conditions” and 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 specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

#### **1.3 SUMMARY**

- A. This Section includes the following:
  - 1. Interior lighting fixtures, lamps, and ballasts.
  - 2. Emergency lighting units.
  - 3. Exit signs.
  - 4. Lighting fixture supports.
- B. Related Sections include the following:
  - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
  - 2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for LED fixtures.

#### **1.4 DEFINITIONS**

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. LER: Luminaire efficacy rating.
- D. Luminaire: Complete lighting fixture, including ballast housing if provided.



## 1.5 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of lighting fixture including dimensions.
  - 2. Emergency lighting units including battery and charger.
  - 3. Ballast.
  - 4. Energy-efficiency data.
  - 5. Life, output, and energy-efficiency data for lamps.
  - 6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
    - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
    - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Warranties: Special warranties specified in this Section.

## 1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- 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. Comply with NFPA 70.
- D. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

## 1.7 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-detection system, and partition assemblies.

## 1.8 WARRANTY

- A. 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 LED Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining four years.

- B. Special Warranty for Electronic Drivers: Manufacturer's standard form in which driver manufacturer agrees to repair or replace drivers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Electronic Drivers: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- 1. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product.

### 2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. LED Fixtures: Comply with UL 1598. Where LED is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. 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.
- E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
  - 4. Laminated Silver Metallized Film: 90 percent.
- F. Plastic Diffusers, Covers, and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass, unless otherwise indicated.

## 2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS (if applicable)

- A. Electronic Ballasts: Comply with ANSI C82.11; programmed-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.
1. Sound Rating: A.
  2. Total Harmonic Distortion Rating: Less than 10 percent.
  3. Transient Voltage Protection: IEEE C62.41, Category A or better.
  4. Operating Frequency: 20 kHz or higher.
  5. Lamp Current Crest Factor: 1.7 or less.
  6. BF: 0.85 or higher.
  7. Power Factor: 0.98 or higher.
  8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
- B. Ballasts for Low-Temperature Environments:
1. Temperatures 0 Deg F and Higher: Electronic or electromagnetic type rated for 0 deg F starting and operating temperature with indicated lamp types.
  2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.

## 2.4 EMERGENCY LED POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
1. Emergency Connection: Operate 1 driver and array continuously at an output of 1400 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture driver.
  2. Test Push Button and Indicator Light: Visible and accessible without opening fixture 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.
  3. Battery: Sealed, maintenance-free, nickel-cadmium type.
  4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  5. 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 flashing red LED.

## 2.5 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

## 2.6 FLUORESCENT LAMPS (if applicable)

- A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 82 (minimum), color temperature 3500 K, and average rated life 20,000 hours, unless otherwise indicated.
- C. T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 82 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.
- D. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at 3 hours operation per start, and where required, suitable for use with dimming ballasts, unless otherwise indicated.
  - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
  - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
  - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
  - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
  - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
  - 6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
  - 2. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- C. Adjust aimable lighting fixtures to provide required light intensities.
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

**END OF SECTION 265100**

## SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

### 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.
- B. The specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Communications equipment coordination and installation.
  - 2. Sleeves for pathways and cables.
  - 3. Sleeve seals.
  - 4. Grout.
  - 5. Common communications installation requirements.

#### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For sleeve seals.
- B. Submit as required in section 01300.

#### 1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications 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 pathways, 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 communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## PART 2 - PRODUCTS

### 2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- 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.

### 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
    - e. Or approved equal.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
  - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS 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. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communication equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays 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 pathway 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 pathway 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 pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

- K. 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.
- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

### 3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

**END OF SECTION 270500**



## SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

### 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.
- B. The specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pathways.
  - 2. UTP cable.
  - 3. Single Mode, SM1, optical fiber cabling.
  - 4. Cable connecting hardware, patch panels, and cross-connects.
  - 5. Cabling identification products.

#### 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.

#### 1.4 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

## 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. Cabling administration drawings and printouts.
  - 3. Wiring diagrams to show typical wiring schematics including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 4. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
  - 5. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
    - a. Vertical and horizontal offsets and transitions.
    - b. Clearances for access above and to side of cable trays.
    - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
    - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Maintenance Data: For splices and connectors to include in maintenance manuals.
- F. 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.
- G. Submit as required in section 01300.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field-testing program development by an RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
  - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

- B. Testing Agency Qualifications: An NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. 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.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- 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. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-B.
- F. Grounding: Comply with ANSI-J-STD-607-A.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
  - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
  - 3. Test each pair of UTP cable for open and short circuits.

## 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

## 1.11 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

## PART 2 - PRODUCTS

### 2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-B.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
  - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep. Use 4"x4" boxes (same for receptacles and switches) with appropriate cover to interface with data outlet covers.

### 2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels. Line entire IT room.

### 2.3 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Corning Cable Systems.
  - 2. Mohawk; a division of Belden CDT.
  - 3. Superior Essex Inc.
  - 4. 3M.
  - 5. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. Description: Single Mode, SM1, fiber, nonconductive, tight buffer, optical fiber cable. Number of strands as indicated on the drawings.
  - 1. Comply with ICEA S-83-596 for mechanical properties.
  - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
  - 3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
  - 5. Conductive cable shall not be used.
  - 6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
  - 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

- C. Jacket:

1. Jacket Color: Black for Single Mode, SM1 cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

## 2.4 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ADC.
  2. American Technology Systems Industries, Inc.
  3. Corning Cable Systems.
  4. Hubbell Premise Wiring.
  5. Optical Connectivity Solutions Division; Emerson Network Power.
- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
  1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- C. Patch Cords: Factory-made, dual-fiber cables in 60-inch (1525-mm) lengths. Provide quantity for total fiber termination.
- D. Cable Connecting Hardware:
  1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
  2. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
  3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

## 2.5 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

## 2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## 2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches (76 mm) above finished floor.

5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

### 3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  1. Comply with TIA/EIA-568-B.1.
  2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  3. Install 110-style IDC termination hardware unless otherwise indicated.
  4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
  8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  9. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
  10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
  11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. Optical Fiber Cable Installation:
  1. Comply with TIA/EIA-568-B.3.
  2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- D. Open-Cable Installation:
  1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
  3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 4-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG (see plans) grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.7 IDENTIFICATION



- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  - 1. Administration Class: 2.
  - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.
- D. Comply with requirements in Division 27 Section "Communications Horizontal Cabling" for cable and asset management software.
- E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- G. Cable and Wire Identification:
  - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
  - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
  - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  4. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

**END OF SECTION 271300**

## **SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING**

### **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.
- B. The specification Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL forms a part of this section and shall have the same force and effect as if printed herewith in full.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.3 SUMMARY**

- A. Section Includes:
  - 1. Pathways.
  - 2. UTP cabling.
  - 3. Coaxial cable.
  - 4. Multiuser telecommunications outlet assemblies.
  - 5. Cable connecting hardware, patch panels, and cross-connects.
  - 6. Telecommunications outlet/connectors.
  - 7. Cabling system identification products.

#### **1.4 DEFINITIONS**

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- E. EMI: Electromagnetic interference.
- F. IDC: Insulation displacement connector.
- G. LAN: Local area network.
- H. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlets/connectors.

- I. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- J. RCDD: Registered Communications Distribution Designer.
- K. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.
- L. UTP: Unshielded twisted pair.

#### 1.5 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
  - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
  - 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

#### 1.6 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.
- B. Note: All Cat6 cable shall be terminated as if for data. This will allow a "plug and play" configuration for telephone and/or data connections based on how it is patched in the IT room. All telephone cables shall be terminated (with lightning protection) in cross block and ultimately terminated in a patch panel.

#### 1.7 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  3. Cabling administration drawings and printouts.
  4. Wiring diagrams to show typical wiring schematics, including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  5. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
  6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
    - a. Vertical and horizontal offsets and transitions.
    - b. Clearances for access above and to side of cable trays.
    - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
    - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- C. Field quality-control reports.
- D. 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.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Layout Responsibility: Preparation of Shop Drawings Cabling Administration Drawings, and field testing program development by an RCDD.
  2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
- B. 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.
1. Flame-Spread Index: 25 or less.
  2. Smoke-Developed Index: 50 or less.
- 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. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- E. Grounding: Comply with ANSI-J-STD-607-A.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test each pair of UTP cable for open and short circuits.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry.

1.11 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
  - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep. Use 4"x4" box with appropriate box covers/adapters suitable for purpose and data outlet mounting.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Belden CDT Inc.; Electronics Division.
  - 2. Superior Essex Inc.

3. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. Description: 100-ohm, 4-pair UTP, formed into 25-pair, binder groups covered with a green thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
  2. Comply with TIA/EIA-568-B.1 for performance specifications.
  3. Comply with TIA/EIA-568-B.2, Category 6e.
  4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

## 2.4 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Premise Wiring.
  2. Leviton Voice & Data Division.
  3. Panduit Corp.
  4. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, four-pair cables in 9-foot lengths; terminated with eight-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6e performance. Patch cords shall have latch guards to protect against snagging.
  2. Patch cords shall have color-coded boots for circuit identification.
  3. Number of patch cords to match number of ports on patch panel(s).

## 2.5 COAXIAL CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
  2. Belden CDT Inc.; Electronics Division.
  3. CommScope, Inc.
- B. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- C. RG59/U (Plenum Rated): NFPA 70, Type CMP.
1. No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
  2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
  3. Copolymer jacket.
- D. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
1. CATV Cable: Type CATV or CATVR.
  2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
  3. CATV Riser Rated: Type CATVR, complying with UL 1666.
  4. CATV Limited Rating: Type CATVX.

## 2.6 COAXIAL CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aim Electronics; a brand of Emerson Electric Co.
  2. Leviton Voice & Data Division.
  3. Siemon Co. (The).
- B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

## 2.7 CONSOLIDATION POINTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Chatsworth Products, Inc.
  2. Hubbell Premise Wiring.
  3. Panduit Corp.
- B. Description: Consolidation points shall comply with requirements for cable connecting hardware.
1. Number of Terminals per Field: One for each conductor in assigned cables.
  2. Number of Connectors per Field:
    - a. One for each four-pair UTP cable indicated.
    - b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.
  3. Mounting: Wall or Furniture.
  4. NRTL listed as complying with UL 50 and UL 1863.
  5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.



## 2.8 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Chatsworth Products, Inc.
  - 2. Hubbell Premise Wiring.
  - 3. Panduit Corp.
- B. Description: MUTOAs shall meet the requirements for cable connecting hardware.
  - 1. Number of Terminals per Field: One for each conductor in assigned cables.
  - 2. Number of Connectors per Field:
    - a. One for each four-pair UTP cable indicated.
    - b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.
  - 3. Mounting: Recessed in ceiling, Wall, Furniture.
  - 4. NRTL listed as complying with UL 50 and UL 1863.
  - 5. Label shall include maximum length of work area cords, based on TIA/EIA-568-B.1.
  - 6. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

## 2.9 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate. (2) Data, (2) spare.
  - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
  - 2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
    - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
  - 3. Legend: Machine printed, in the field, using adhesive-tape label.
  - 4. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

## 2.10 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

## 2.11 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

## 2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters, except in accessible ceiling spaces. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches (76 mm) above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

### 3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. MUTOA shall not be used as a cross-connect point.
  - 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
    - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    - b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
  - 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  - 10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
  - 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
  2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
  3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
  2. Install cabling after the flooring system has been installed in raised floor areas.
  3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.
- F. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
  2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
- G. Group connecting hardware for cables into separate logical fields.
- H. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
  2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
  3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
  4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  1. Administration Class: 2.
  2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.
- D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet ((4.5) m).
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
  - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
  - b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

### 3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
  - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. UTP Performance Tests:

- a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
  - 1) Wire map.
  - 2) Length (physical vs. electrical, and length requirements).
  - 3) Insertion loss.
  - 4) Near-end crosstalk (NEXT) loss.
  - 5) Power sum near-end crosstalk (PSNEXT) loss.
  - 6) Equal-level far-end crosstalk (ELFEXT).
  - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
  - 8) Return loss.
  - 9) Propagation delay.
  - 10) Delay skew.
6. Coaxial Cable Tests: Conduct tests according to Division 27 Section "Master Antenna Television System."
7. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
  - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
  - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

**END OF SECTION 271500**

SCHEDULE OF MATERIAL SUBMITTALS HVAC (.2)											FED. PROJECT # DMVA/BMCE- 42190067	PROJECT TITLE Fort Mifflin Bldg. 57		D.G.S PROJECT NUMBER: N/A						
TO BE COMPLETED BY PROJECT ENGINEER											TO BE COMPLETED BY CONTRACT ADMINISTRATOR									
LINE NUMBER	ITEM OR DESCRIPTION OF ITEM, CONTRACT REFERENCE, TYPE OF SUBMITTAL	NUMBER OF COPIES REQUIRED									REQUIRED SUBMISSION DATE	DATE RECEIVED IN CONTRACTING	DATE TO MECHANICAL ENGINEERING	RETURN SUSPENSE DATE	SUBMITTAL NUMBERS	DATE CONTRACTOR NOTIFIED		CONTRACTOR RESUBMITTAL	FINAL APPROVAL	REMARKS
		STEEL CERTIFICATE OF COMPLIANCE	SHOP DRAWINGS	SCHEDULES	COLOR SELECTION	MANUFACTURER' S RECOMMENDATIONS	MANUFACTURER' S WARRANTY	CATALOG DATA	OPERATING INSTRUCTIONS	REPORTS						DELEGATED DESIGN	APPROVED			
1	230515-General Duty Valves		5				5				NTP +10									A,B
2	230515-Hangers and Supports for HVAC Equip. & Piping		5				5				NTP +10									A,B
3	230590-Testing, Adjusting and Balancing								5											A,B
4	230710-Duct Insulation		5				5				NTP +10									A,B
5	233110- Metal Ducts		5				5				NTP +10									A,B
6	233110-Air Duct Accessories		5				5	5			NTP +10									A,B
7	233400-Overhead Fans		5				5	5			NTP +10									A,B
8	233423 – HVAC Power Ventilators		5				5	5			NTP +10									A,B
9	233710-Diffusers and Grilles		5				5				NTP +10									A,B
10	235400-FURNACES		5				5				NTP +10									A,B
11	238126 - Split-System Air- Conditioners		5				5				NTP +10									A,B
12	Various – Equipment Training, O&M Manuals						3	3												A,B



SCHEDULE OF MATERIAL SUBMITTALS HVAC (.2)											FED. PROJECT # DMVA/BMCE- 42190067		PROJECT TITLE Fort Mifflin Bldg. 57		D.G.S PROJECT NUMBER: N/A					
TO BE COMPLETED BY PROJECT ENGINEER											TO BE COMPLETED BY CONTRACT ADMINISTRATOR									
LINE NUMBER	ITEM OR DESCRIPTION OF ITEM, CONTRACT REFERENCE, TYPE OF SUBMITTAL	NUMBER OF COPIES REQUIRED									REQUIRED SUBMISSION DATE	DATE RECEIVED IN CONTRACTING	DATE TO MECHANICAL ENGINEERING	RETURN SUSPENSE DATE	SUBMITTAL NUMBERS	DATE CONTRACTOR NOTIFIED		CONTRACTOR RESUBMITTAL	FINAL APPROVAL	REMARKS
		STEEL CERTIFICATE OF COMPLIANCE	SHOP DRAWINGS	SCHEDULES	COLOR SELECTION	MANUFACTURER' S RECOMMENDATIONS	MANUFACTURER' S WARRANTY	CATALOG DATA	OPERATING INSTRUCTIONS	REPORTS						DELEGATED DESIGN	APPROVED			
13	017839 – Hard Copy of As-Built Drawings									3										A,B
14	017839 – CDRom of As-Built Drawings in AutoCAD									3										A,B

- A. No deviations, substitutions or changes of materials, to be incorporated into this project, shall be made after approval by the Department, except for written direction by and the approval of the manufacturer of a specific item and re-approval by the Department.
- B. The Department retains the right to require additional items not specifically denoted to be submitted for approval and/or additional clarification.

SCHEDULE OF MATERIAL SUBMITTALS <b>PLUMBING (.3)</b>											FED. PROJECT # <b>DMVA/BMCE-42190067</b>		PROJECT TITLE <b>Fort Mifflin Bldg. 57</b>		D.G.S PROJECT NUMBER: <b>N/A</b>					
TO BE COMPLETED BY PROJECT ENGINEER											TO BE COMPLETED BY CONTRACT ADMINISTRATOR									
LINE NUMBER	ITEM OR DESCRIPTION OF ITEM, CONTRACT REFERENCE, TYPE OF SUBMITTAL	NUMBER OF COPIES REQUIRED									REQUIRED SUBMISSION DATE	DATE RECEIVED IN CONTRACTING	DATE TO MECHANICAL ENGINEERING	RETURN SUSPENSE DATE	SUBMITTAL NUMBERS	DATE CONTRACTOR NOTIFIED		CONTRACTOR RESUBMITTAL	FINAL APPROVAL	REMARKS
		STEEL CERTIFICATE OF COMPLIANCE	SHOP DRAWINGS	SCHEDULES	COLOR SELECTION	MANUFACTURER' S RECOMMENDATIONS	MANUFACTURER' S WARRANTY	CATALOG DATA	OPERATING INSTRUCTIONS	REPORTS						DELEGATED DESIGN	APPROVED			
1	221110 – Plumbing Insulation						5				NTP +30									A,B
2	221110 – Domestic Water Piping						5				NTP +30									A,B
3	221110 – Domestic Water Piping Valves and Specialties (balancing, check, ball, arresters)						5				NTP +30									A,B
4	221110 – Sanitary Waste and Vent Piping						5				NTP +30									A,B
5	221310 – Sanitary Waste Piping Specialties (floor drains, cleanouts)						5				NTP +30									A,B
6	221343 - Facility Packaged Sewage Pumping Stations						5				NTP +30									A,B
7	223300 –Domestic Water Heaters					x	5	x	x		NTP +30									A,B
8	224000 – Plumbing Fixtures (water closets, flush valves, toilet seats, etc.)					x	5	x			NTP +30									A,B
9	224000 – Plumbing Fixtures (urinals, flush valves, supports, etc.)					x	5	x			NTP +30									A,B
10	224000 – Plumbing Fixtures (lavatories, faucets, supports, shielding guards, etc.)					x	5	x			NTP +30									A,B
11	224000 – Plumbing Fixtures (lavatory, faucets, etc.)					x	5	x			NTP +30									A,B

SCHEDULE OF MATERIAL SUBMITTALS <b>PLUMBING (.3)</b>											FED. PROJECT # <b>DMVA/BMCE-42190067</b>		PROJECT TITLE <b>Fort Mifflin Bldg. 57</b>		D.G.S PROJECT NUMBER: <b>N/A</b>					
TO BE COMPLETED BY PROJECT ENGINEER											TO BE COMPLETED BY CONTRACT ADMINISTRATOR									
LINE NUMBER	ITEM OR DESCRIPTION OF ITEM, CONTRACT REFERENCE, TYPE OF SUBMITTAL	NUMBER OF COPIES REQUIRED									REQUIRED SUBMISSION DATE	DATE RECEIVED IN CONTRACTING	DATE TO MECHANICAL ENGINEERING	RETURN SUSPENSE DATE	SUBMITTAL NUMBERS	DATE CONTRACTOR NOTIFIED		CONTRACTOR RESUBMITTAL	FINAL APPROVAL	REMARKS
		STEEL CERTIFICATE OF COMPLIANCE	SHOP DRAWINGS	SCHEDULES	COLOR SELECTION	MANUFACTURER'S RECOMMENDATIONS	MANUFACTURER'S WARRANTY	CATALOG DATA	OPERATING INSTRUCTIONS	REPORTS						DELEGATED DESIGN	APPROVED			
12	224000 – Plumbing Fixtures (mop receptor, faucet, etc.)						<b>x</b>	<b>5</b>	<b>x</b>			<b>NTP +30</b>								A,B
13	Various – O&M Manuals									<b>2</b>										A,B
14	017839 – Hard Copy of As-Built Drawings									<b>3</b>										A,B
15	017839 – CDRom of As-Built Drawings in AutoCAD format									<b>2</b>										A,B

- A. No deviations, substitutions or changes of materials, to be incorporated into this project, shall be made after approval by the Department, except for written direction by and the approval of the manufacturer of a specific item and re-approval by the Department.
- B. The Department retains the right to require additional items not specifically denoted to be submitted for approval and/or additional clarification.



